MAY 1944 – FIFTIETH YEAR

MACHINERY

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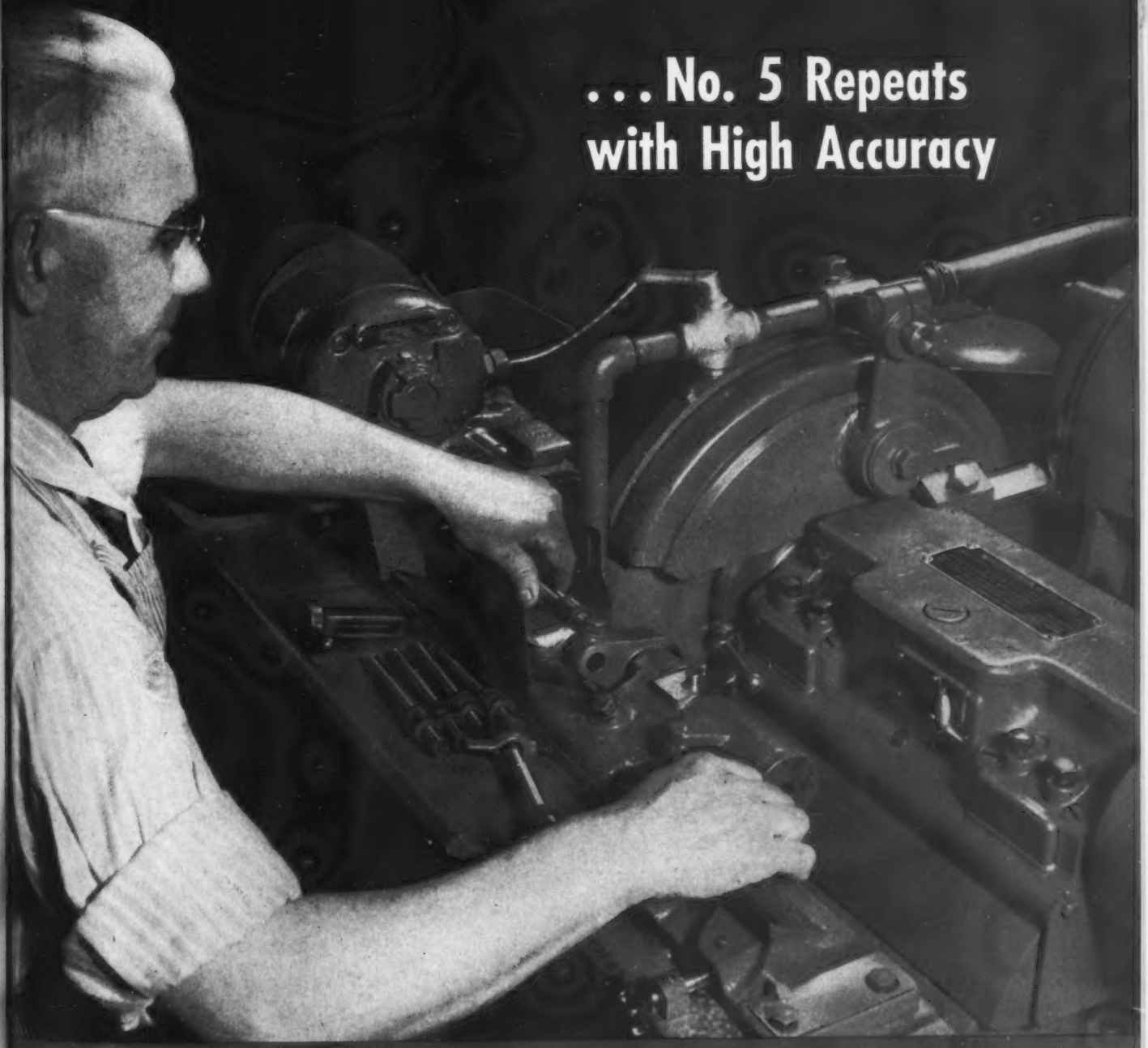

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SEE PAGE 191

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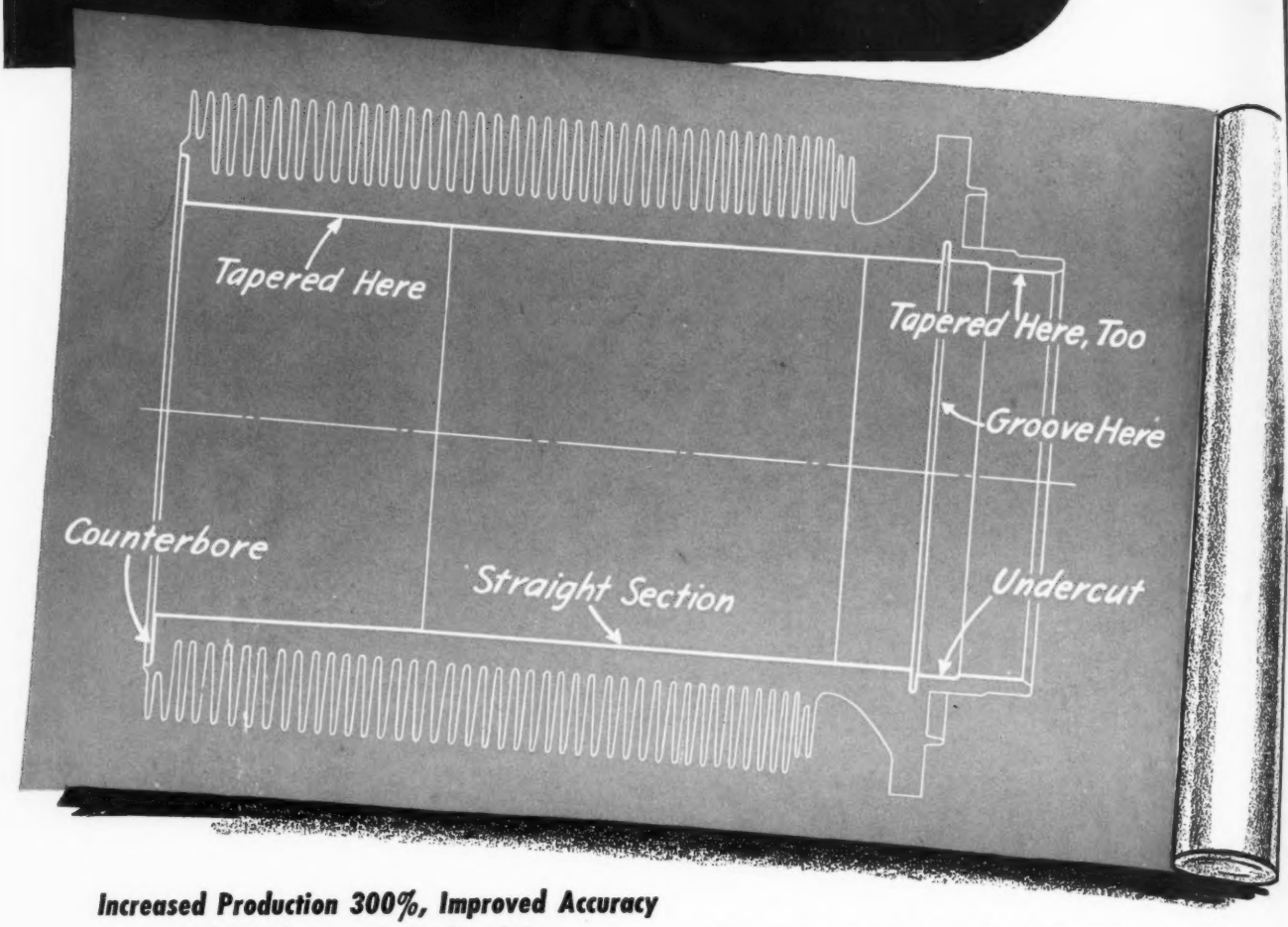

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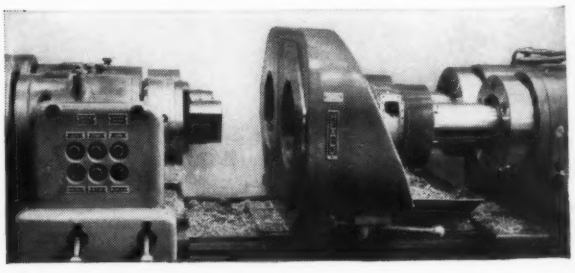

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MACHINERY

The importance of oils and lubricants will be one of the principal subjects to be dealt with in June MACHINERY. There will be an article describing how oil salvage promotes war economy. This article deals with the methods used in salvaging oil by one of the largest aircraft-engine manufacturers in the country. Another article will treat of the importance of lubrication in reducing maintenance costs. The subject of hydraulic oils for machine tools will be covered in an exhaustive article on the properties of hydraulic oils and the methods for testing such oils to determine their relative advantages.

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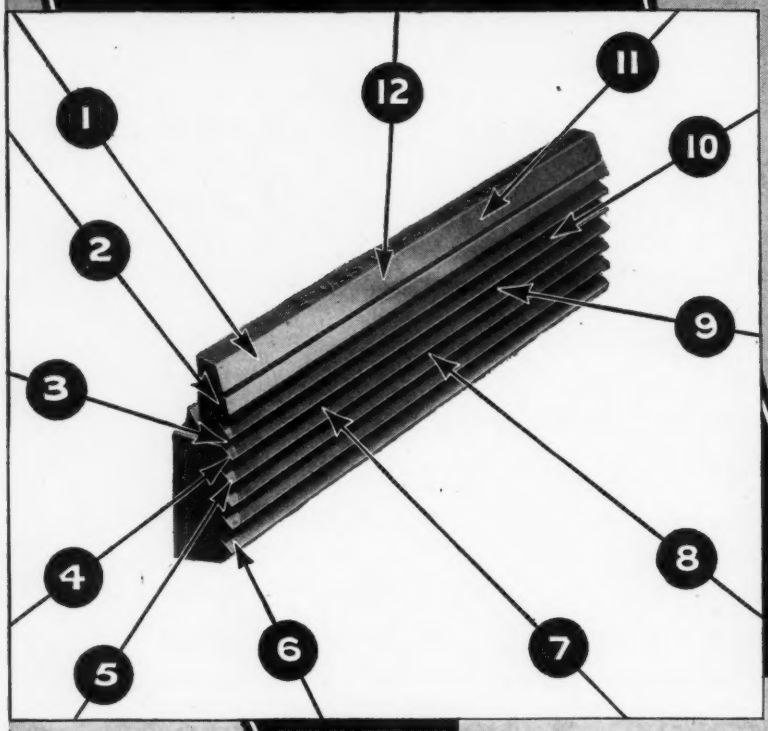

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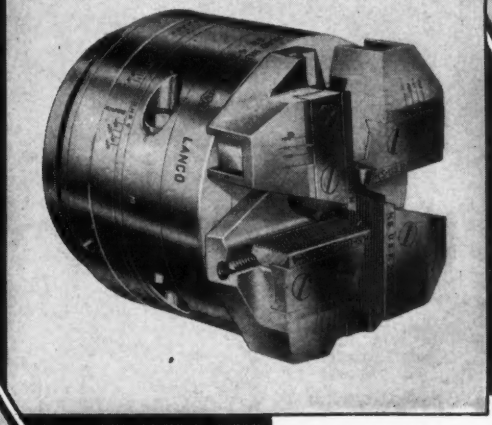

1–Permanent throat permits close to shoulder threading throughout life of chasers

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4–Simple grinding operation renews entire cutting edge and leading feature

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6–Leading feature insures thread of accurate lead

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MACHINERY
Vol. 50 No. 9
MAY, 1944

ELECTRONICS for the MACHINE DESIGNER

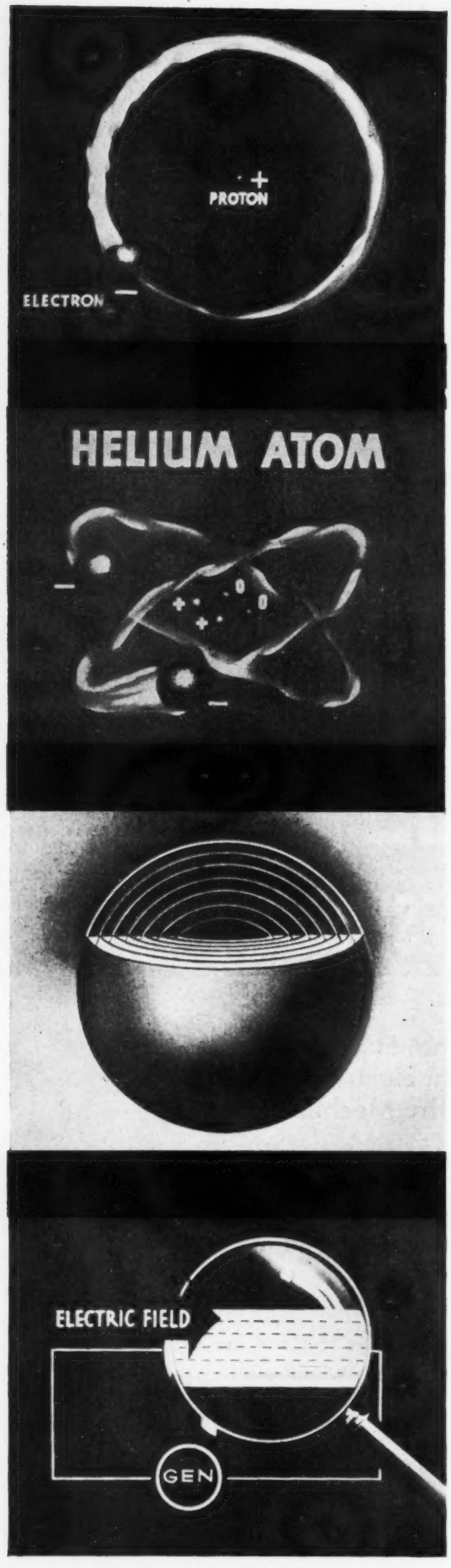
This Motor Speed Control is but One of Many Electronic Devices Now being Used to Improve the Performance of a Wide Variety of Machines

First in a Series of Articles on the Fundamentals of Electronics and the Ways in which Electronic Devices can be Advantageously Applied in the Mechanical Field

By G. A. CALDWELL, Manager, General Mills Section, Industry Engineering and CARL MADSEN, Electronics Engineer, Industry Engineering
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ELECTRONICS is that branch of science and technology which deals with the conduction of electricity in two ways—through a vacuum and through a gas. During the early days of the electrical industry, such forms of conduction had no commercial application. Then industry was interested only in the conduction of electricity through liquids known as electrolytes and through metals such as copper wires, cables, and switch gear.

But today, the conduction of electricity through vacuum and gases has been put to work, not only in the communications field, but in the broad field of general industry as well. Thus, it is important for engineers, designers, and production men in the metal-working field to be informed on the fundamentals of electronics and its potentialities for improving their products from such standpoints as performance, cost, service life, maintenance, and ease of control.



Where electronic equipment is applicable, it has often accomplished surprising and apparently miraculous results. This has led to extravagant claims by the enthusiastic and unwarranted expectations by the uninformed. It should be made clear, however, that electronics is no panacea for all problems of regulation, control, inspection, heating, etc. There are many instances where other devices will do the job more cheaply, more efficiently, or with simpler equipment.

This series of articles will deal specifically with that which has been successfully accomplished or is anticipated in the immediate future. Thus, specific electronic applications which have been made to products of the metal-working industry will be reviewed, and new applications indicated that give definite promise of usefulness but have not yet reached the stage of commercial exploitation. Before this most interesting phase of the subject is discussed, a brief review of the fundamentals of electronic theory, some basic types of electronic tubes, and their broad fields of application will provide a basis for a clearer understanding of what is to follow.

Fundamentals of Electronic Theory—Simplified

A few basic facts concerning the electron theory of matter will help to give meaning to some of the terms and phrases that are necessary for an adequate description of various types of electronic equipment and their functions. According to this theory, all matter is made up of atoms, the structure of which is similar to that of our solar system. In a normal atom of hydrogen, for example, a large but relatively light *electron* "planet" revolves around a small but relatively heavy *proton* "sun" (Fig. 1). Each of these two bodies has exactly the same charge of electricity, a charge so minute that it is measured in the ten billion-billionth part of a coulomb. (A coulomb is the quantity of electricity that is transmitted when a current of one ampere flows for one second.) This minute charge represents the smallest particle into which electrical energy can be divided. It is now believed to be the fundamental indivisible electric charge of the universe.

The atoms of each chemical element have their own unique structure. The structure of the normal hydrogen atom is the simplest of all, with but two elements—a central nucleus, or proton, and a revolving electron. The atoms of the other elements are more complex in that they have many electrons revolving about a central "sun," or in some cases about a group of several "suns."

These electrons rotate in different planes and at different distances from the center of the atom (Fig. 2). The electron orbits may be visualized as occurring in several concentric space shells of successively larger diameter (Fig. 3). Each of these space shells may be thought of as having the capa-

city to accommodate a certain number of rotating electrons.

In many substances, these rotating electrons are strongly bound to their central "suns" or nuclei by interatomic attraction. In metals, however, the atoms are close together, and because of this extreme nearness, an outer-shell electron can be attracted equally by several neighboring atoms. Some of these outer electrons are thus drawn out of their regular orbits and can no longer be identified with a particular atom, but become a part of neighboring atoms from instant to instant. An electron which may move from one atom to another and is not bound to the central nucleus of any atom is known as a "free" electron.

In good conductors, free outer-shell electrons engage continuously in random movement from atom to atom. Exactly the opposite is true in an insulating material; in such materials, electrons do not tend to move freely from atom to atom, but are bound tightly by their respective atomic systems.

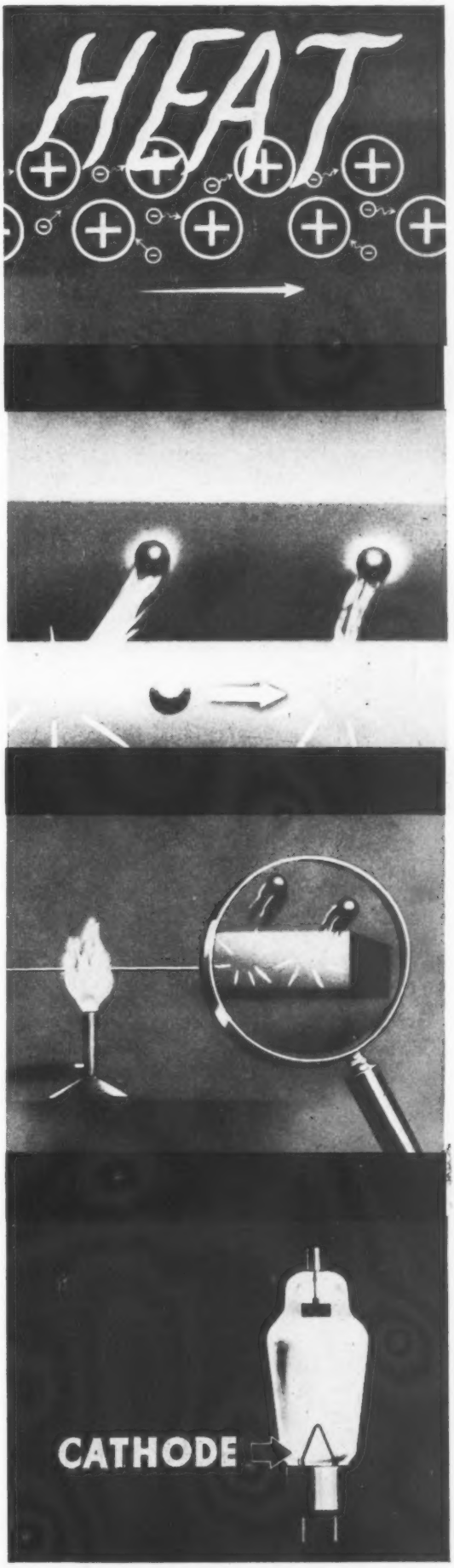
Thus, in review we can say: (1) Each atom consists of a nucleus, positive in charge, around which revolve one or more planetary electrons, negative in charge. (2) Each element differs chemically from other elements because of the total number of protons and electrons in its constituent atoms. (3) In more complex atoms, planetary electrons occur in several concentric space shells. (4) A good conductor contains a large number of free electrons which engage continuously in random movements from atom to atom. (5) An electron carries the smallest charge into which electrical energy can be divided; this charge is one of the ultimate indivisible building blocks of the universe.

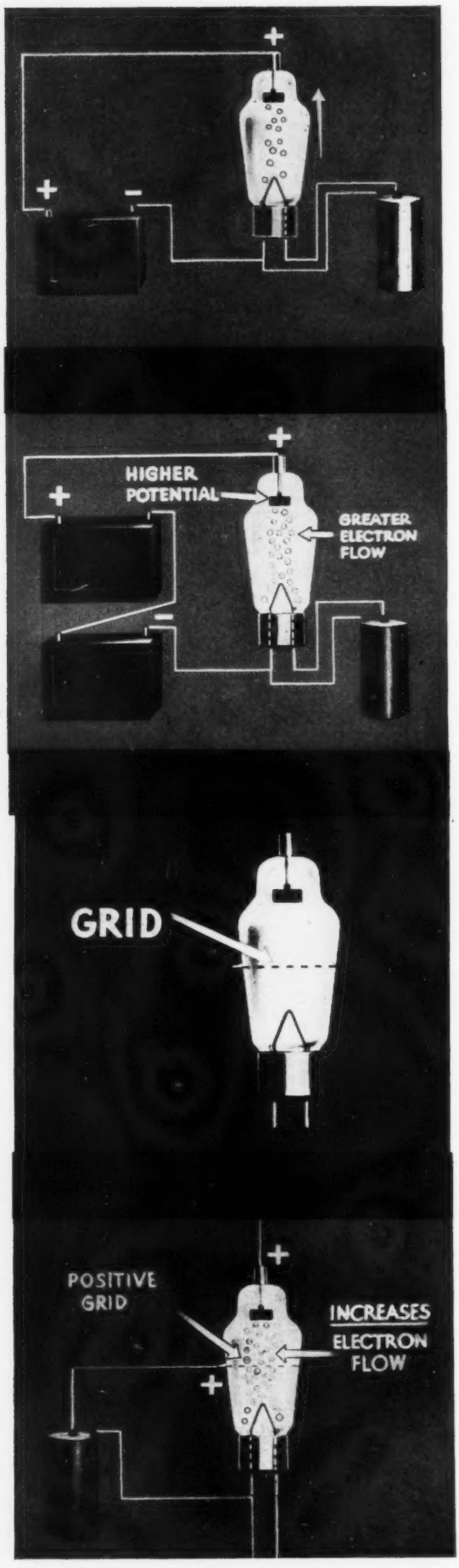
Electronic Emission — What It is and Why It is Important

When voltage is applied to an electrical conductor, as when the two ends of a wire are connected to a battery, an electric field is created inside the conductor (Fig. 4). This electric field gives direction to the random movements of the free electrons and results in their slow average drift along the conductor, producing an electric current flow.

It should be made clear that although the average drift of the electrons themselves through a wire is probably at the rate of only a few inches per minute, the resulting electric current travels at a speed approximating that of light. This may be explained by the fact that it is not the drift of electrons through the wire which represents the actual current flow, but rather the series of impulses transmitted from one electron to another along the wire, much as the successive impacts of a line of freight cars, one against the other, might move extremely rapidly down the line, although the freight cars themselves were moving very slowly.

When numerous free electrons gain velocity due to the influence of an electric field they collide with





atoms, thus losing their increased energy imparted by the electric field, and this energy is transferred by the impact into random atomic motion. This random atomic and electronic agitation is what constitutes heat (Fig. 5). Increased agitation raises the temperature of the conductor. At high temperatures, some of the electrons may absorb enough energy to break away from the surface of the conductor (Fig. 6). This is called electronic emission.

In the case of an incandescent lamp, electrons break away freely from the surface of the hot filament and hover around it as an electronic cloud. Heating a solid with an ordinary gas flame will also cause the emission of electrons from the solid. Electronic emission can also be caused by light and other factors besides heat. Electronic emission is important, because without it, an electric current could not flow through a vacuum or gas-filled space, and there would be no electronic tubes.

How the Electronic Tube Functions

The operation of every electronic tube depends upon the emission of electrons. At normal room temperatures a solid, such as a piece of copper, does not emit electrons in any appreciable quantity. In order to enable the free electrons to overcome the attraction of the atoms constituting the metal, extra energy must be provided (Fig. 7). There are four methods by which this extra energy is supplied. The two most commonly utilized are by heat energy, which produces what is called *thermionic emission* of electrons; or by light energy, which produces what is known as *photoelectric emission* of electrons.

An electronic tube is a device providing an enclosed evacuated or gas-filled space containing two or more metallic elements between which a flow of emitted electrons takes place when the tube is in operation. In a two-element tube, electrons are emitted from the surface of one element, called the *cathode* (Fig. 8), and pass through the gas-filled space or vacuum to a second tube element, known as the *anode*.

To enable electrons to be emitted from it, the cathode is connected to a source of electric potential, and becomes heated, in much the same way as the filament of an incandescent lamp. The anode is connected to the positive terminal of an electrical supply source (Fig. 9). Because of the resulting positive potential imparted to the anode, negatively charged electrons emitted from the heated cathode are strongly attracted and move toward the anode at tremendous speed.

This flow of electrons through the vacuum or gas-filled space of the tube can be controlled in several ways. One way is by variation of the anode potential. The higher this positive potential, the more the negative electrons are attracted and the greater the flow (Fig. 10). Another way is by variation of the force causing cathode emission, such as by using a higher heating current.

But a far more important and useful control is obtained by introducing a third element known as the *grid* into the tube between the cathode and the anode (Fig. 11). Thus, electrons on their way from the cathode to the anode must pass through the grid. If the grid is made positive, it aids the anode in pulling a greater number of negatively charged electrons emitted by the cathode through the intervening space (Fig. 12). If the grid is made negative, it opposes the passage of electrons from cathode to anode, and consequently reduces or completely cuts off the electron flow (Fig. 13).

Because the grid is closer to the cathode than to the anode, a much smaller change in potential is required to control the electron flow than if it were applied to the anode. Literally hundreds of electronic devices derive their value from the fact that they permit the control of a large flow of current by minute voltage changes on the grid of an electronic tube.

Thus, in review it may be said that (1) Electrons can be emitted from many substances by the effect of heat and light. (2) In an electronic tube, emitted electrons will flow from their source of emission—the cathode—to a point of positive potential—the anode. (3) The most effective and flexible method of controlling electron flow is by varying the potential of a third tube element, called the grid. (4) A small change of potential on the grid can control a large flow of current through the anode or work circuit.

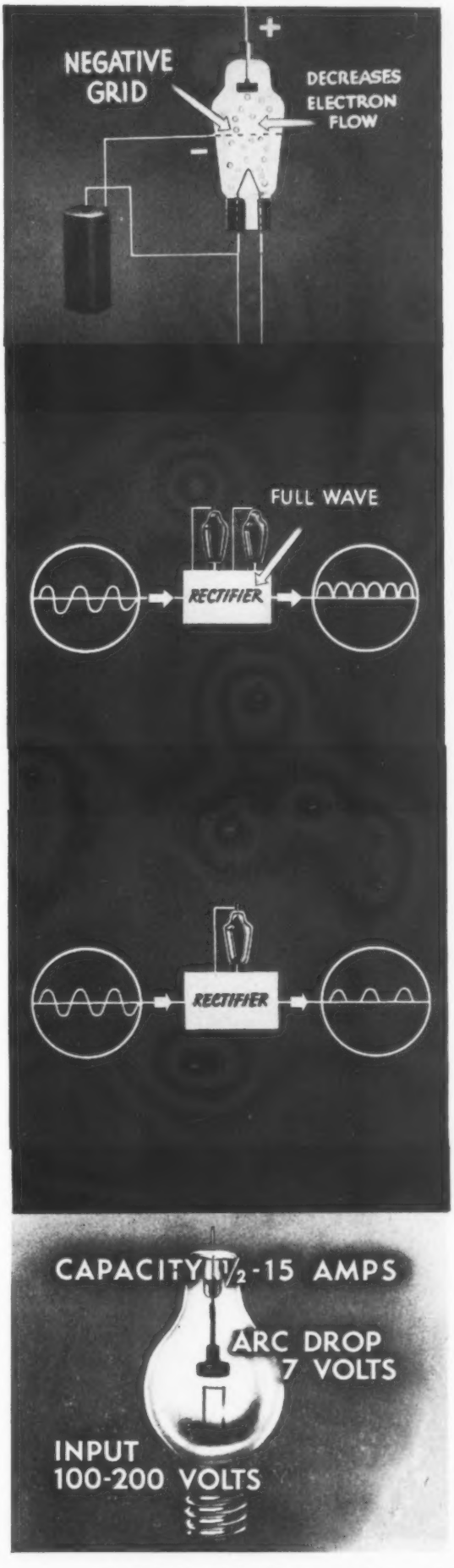
Since the heart of every electronic device is an electronic tube, this discussion will now consider the basic types of electronic tubes and the ways in which they function. Electronic tubes can be used to (1) rectify, (2) amplify, (3) generate, (4) control, (5) convert light into electricity, and (6) convert electricity into light.

Electronic Tubes for Rectifying Alternating Current

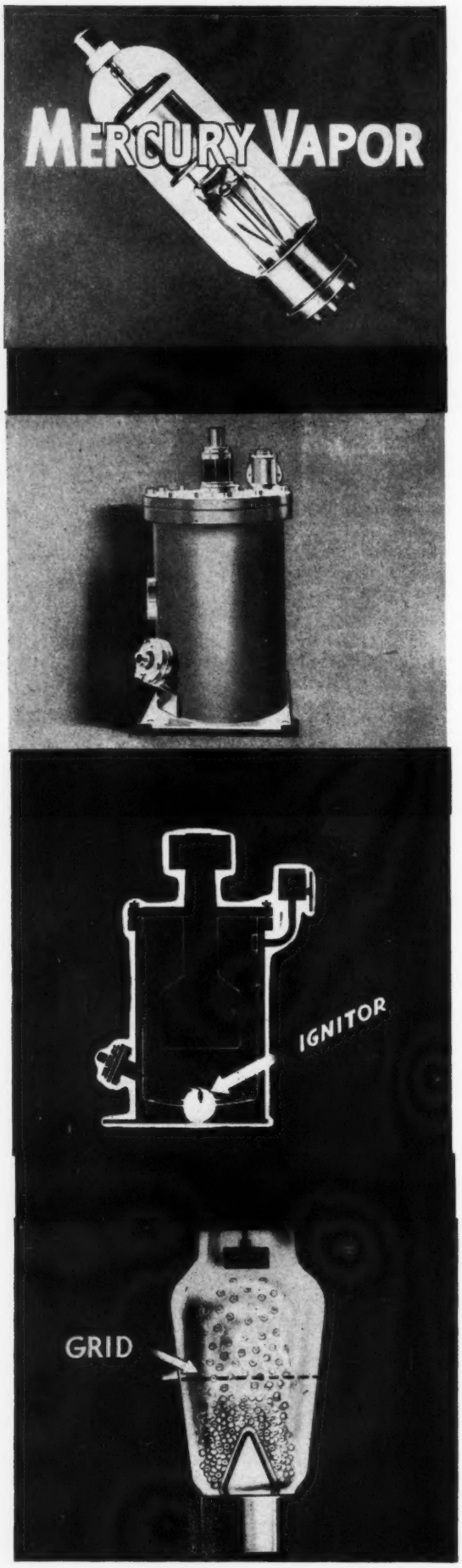
Electronic rectification is the conversion of alternating current into direct current by means of a vacuum tube.* It is made possible by the fact that an electric current will flow in only one direction through a two-element vacuum tube, from the cathode to the anode.

The usual vacuum type rectifying tube, or Kenetron, as it is called, comprises a cathode and an anode. The insulation between them takes the form of a highly evacuated space. This insulating vacuum is bridged when the cathode is heated and a positive potential is applied to the anode. Electrons are then emitted from the cathode and are pulled to the anode by electrostatic attraction.

The electron flow closes what, in effect, is an electric switch. All that is necessary to reopen this switch is to change the polarity of the anode. Then



*Vacuum is used here in a general rather than a technical sense.



the anode repels the electrons emitted by the cathode; the flow of electrons stops, and the vacuum in the tube once more functions as an insulator.

Thus, whenever this two-element Kenetron tube is connected to a source of alternating current, it functions as a rectifier. Every time the alternator produces a positive half wave of voltage, the anode attracts electrons, and current accordingly flows. Every time the alternator produces a negative half wave of voltage the anode repels the electrons and no current flows. In other words, the tube functions as a one-way street, passing electron traffic in one direction, but barring it in the other.

By connecting up two Kenetron tubes in the proper way, the alternating current flows first through one tube and then through the other, so that full-wave rectification is obtained (Fig. 14), resulting in much smoother direct current than when a single tube is used and only half-wave rectification secured (Fig. 15). More than two Kenetrons may be connected together to obtain an even smoother current flow.

Kenetrons, being vacuum tubes, are suitable primarily for high-voltage, low-current applications. Other two-element tubes, filled with a gas, are also used for current rectification where other requirements are to be met. Thus, hot cathode tubes filled with Argon gas, known as Rectigon tubes, are used to provide relatively high current at low voltage (Fig. 16) for charging storage batteries from alternating-current power lines.

Another important example of this class of tubes is the hot cathode tube filled with mercury vapor, called the Phanotron (Fig. 17). Phanotron tubes are built in a range of capacities extending up to 75 amperes, and are suitable for medium power applications. Tubes with higher current carrying capacities, called Ignitrons (Fig. 18), have a mercury pool cathode and depend on timed ignition for conduction (Fig. 19). Ignitrons furnish more than 90 per cent of the rectified current employed in the aluminum industry and in the plants that produce magnesium.

Electronic Tubes for Amplifying Weak Signals

The second basic function of electronic tubes is to amplify. The tubes used for this purpose are called Pliotrons. They contain at least three elements—cathode, anode, and grid (Fig. 20). Electronic amplification can be defined quite simply. It is the process of producing at the anode an enlargement of a weak signal applied at the grid.

It will be recalled that small changes of potential applied at the grid are magnified into large current and voltage variations in the anode circuit. Thus, when a signal that is only slightly positive is applied to the grid, tremendous help is given the anode in its job of pulling electrons away from the area surrounding the heated cathode.

When the signal applied to the grid is but slightly

negative, an equally enlarged effect is produced, but this time in the form of reducing or completely interrupting the electron flow to the anode. The important thing about the function of a Pliotron tube is that the slightest change in potential on the grid representing nearly zero power input produces a large change of current and voltage in the anode circuit (Fig. 21). This effect is confined to Pliotrons or vacuum tubes containing three or more elements. It cannot be obtained in gas-filled tubes.

Electronic amplifying tubes are used in a wide variety of applications which are characterized by the type of load connected to the anode circuit. One form that this load may assume is that of an indicating instrument. Thus, these tubes can be used in a balancing machine to amplify the minute voltages produced by rotor unbalance up to the point where these voltages can be measured by instruments and their cause eliminated.

Again, these tubes may be connected to a photocell which is used to inspect a production line. Every time a change in minute current through the photocell takes place it is sufficiently magnified by the amplifier to actuate a relay which may stop the conveyor belt or perform some other function.

Generating High-Frequency Alternating Current with Electronic Tubes

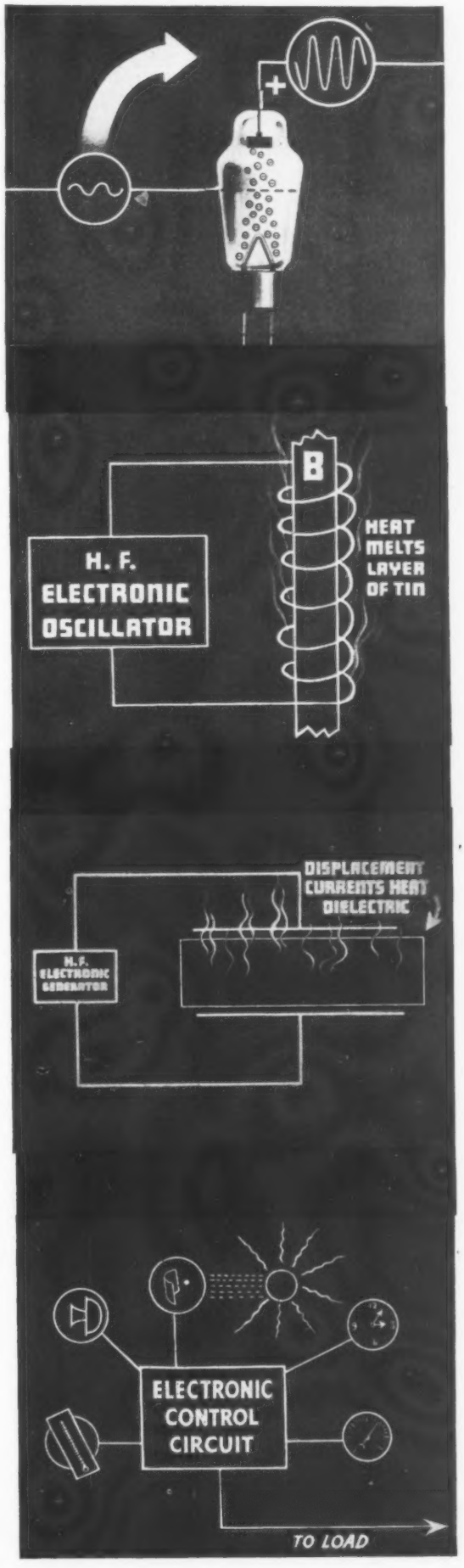
The third function that electronic tubes can perform is to generate alternating currents from a direct-current supply. Vacuum-tube oscillators can produce, with equal ease, frequencies of a few cycles per second or frequencies as high as several hundred million cycles per second, far beyond the range of conventional rotating equipment. They can also produce power outputs ranging up to hundreds of kilowatts.

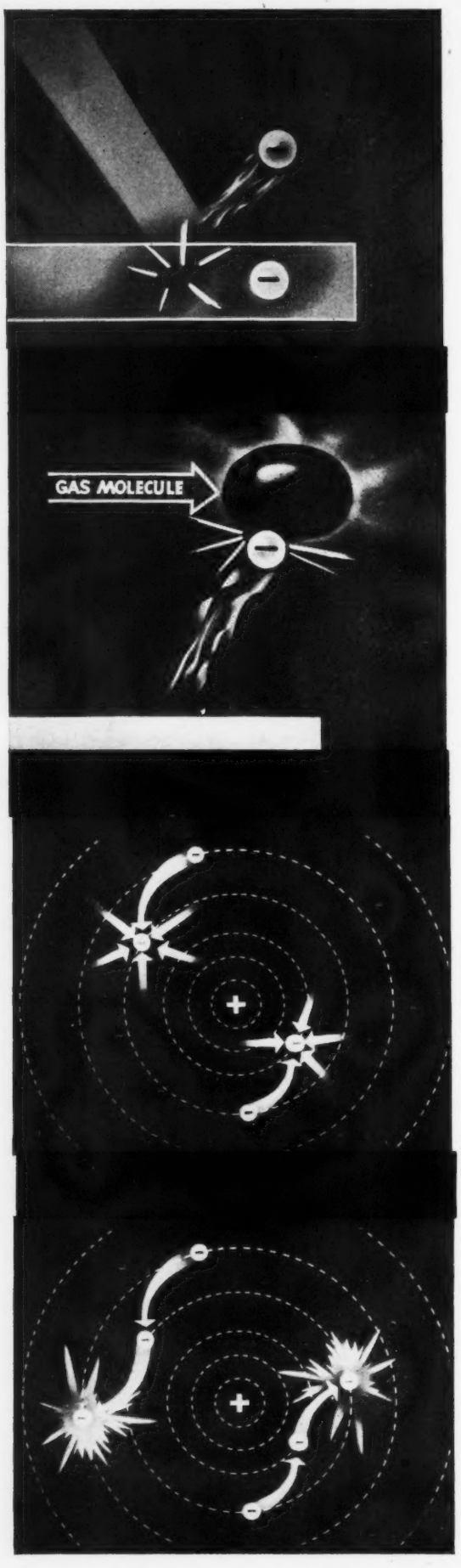
Vacuum tubes, when used as oscillators with an antenna circuit, cause electromagnetic waves to be radiated into space for radio and television transmission. An important industrial application for vacuum-tube oscillators is the production of high-frequency energy for induction heating, which can be applied to soldering operations, brazing, annealing, casehardening, and metal heat-treating of many kinds (Fig. 22).

For non-metallic materials, the vacuum-tube oscillator can be used to produce dielectric heating (Fig. 23), such as is employed in the bonding of plywood sections to form strong structural members or in the softening of plastic raw material preparatory to forming in presses.

Electronic Tubes for Control and Regulation

The fourth chief function of electronic tubes is to control. For example, electronic controls "hear" signals over telephone wires and turn large generators on and off. Others "see" pin holes in swiftly moving steel strip and mark defective sections for





rejection. Still other electronic controls detect heat variations in electric furnaces and automatically regulate the power input to maintain constant temperature.

A fourth type makes possible high quality welds of uniform strength by accurately controlling the entire operational cycle of resistance welders. Smooth, wide-range stepless control of direct-current motors from an alternating-current supply is another development made possible by electronic control. In fact, electronic controls can be made a function of sound, light, temperature, time, and speed, to mention only the most important applications (Fig. 24).

Converting Light into Electricity

The last two functions of electronic tubes, that is, the conversion of light into electricity, and the conversion of electricity into light, are based on a reversible relationship in the interaction of electrons and light. At one moment light energy may eject an electron from the light-sensitive surface of a cathode, thus converting light into electricity (Fig. 25). The next moment the same ejected electron may collide with a molecule of gas, excite it, and cause it to give off radiant energy (Fig. 26). This results in converting electricity back into light.

When light falls on certain substances, such as barium, cesium, potassium, rubidium, or sodium, electrons are emitted from their surfaces. This important characteristic of photo-sensitive substances is put to work by electronic devices known as photo-tubes. These photo-tubes may be classified into two types—vacuum and gas-filled.

A typical vacuum photo-tube contains a cathode coated with a photo-sensitive substance plus an anode of a distinctive shape. When the photo-tube is put to work, these two electrodes are connected in series with a battery, or other source of direct current potential, and a load resistance. Light falling on the cathode causes the emission of electrons in accordance with two basic laws: (1) The velocity of an electron emitted is proportional to the frequency of the light wave. (2) The quantity of electrons emitted is proportional to the light intensity. This photo-tube has, therefore, both color sensitivity and brightness sensitivity, which explains why its control range is so large.

The gaseous type of photo-tube differs from the vacuum type in that it is more susceptible to damage from overload, is less likely to maintain sensitivity over a long period of time, and has a power dynamic response. On the other hand, it has the important characteristic of greater sensitivity to light. Photo-tubes have found many important uses in industry, such as spotting pin-holes in tin plate moving along a shearing line; protecting operators of hazardous machines against injuries; and measuring temperatures in heat-treating furnaces.

CHART 1

VACUUM ELECTRONIC TUBES

TUBE NAMES	KENOTRON ★(Diode)	X-RAY	PLIOTRON ★(May be Triode, Tetrode or Pentode)	CATHODE RAY	MAGNETRON	
APPLICATION	Rectifies low values of current (often at high voltage)	Produces X-ray radiation	Amplification and high frequency oscillation	Produces visual indications by controlled electron beam	Ultra high frequency (U.H.F.) oscillation	
TYPICAL EXAMPLES	Rectification in radio, X-ray, and electrostatic precipitation	•Medical diagnosis and therapy •Examination of industrial products	•High frequency heating •Carrier current •Control circuits •Radio receivers and transmitters	•Circuit analysis •Television	Short wave radio	
TYPE OF CONTROL	None		Electrostatic (Grid)	Electrostatic or Electromagnetic	Electromagnetic field	
TYPE OF CATHODE	Hot					

GAS FILLED ELECTRONIC TUBES

TUBE NAMES	RECTIGON • TUNGAR	PHANOTRON (Mercury Vapor Rectifier)	THYRATRON ★(May be Gas Triode or Gas Tetrode)	PERMATRON	GLOW TUBE • PROTECTOR TUBES (For special applications)
APPLICATION	Low voltage rectification	Rectification of moderate amounts of current at voltages up to 20,000	Control and controlled rectification of moderate amounts of current at voltages up to 22,000		Illumination, rectification and regulation at low current, low voltage
TYPICAL EXAMPLES	Battery charging	Radio transmitters and industrial applications	•Welding control •Timing circuits •Motor control •Voltage regulation		•Switchboard indicating lights •Control circuit voltage regulators •Protection of supervisory control circuits
TYPE OF CONTROL	None		Electrostatic (Grid)	Electromagnetic	None
TYPE OF CATHODE	Hot				Co

THERE are many special purpose tubes used principally in lighting, in therapeutics and in radio which are not classifie clude Fluorescent Lights, Ultra Violet Lamps, Sterilamps, and such tubes as Iconoscopes, Monoscopes, Kinescopes, Ballast Tub

TUBES

MAGNETRON	KLYSTRON • RHUMBATRON	VACUUM PHOTOTUBE
Ultra high frequency (U.H.F.) oscillation	Used in military radio and detection devices	Used in applications where audio frequency response is important
Short wave radio		Sound movies
Electromagnetic field	Resonance chamber	Light variation
		Photoelectric

★ **RADIO TERMINOLOGY**

DIODE—Two elements (anode and cathode)

DUO-DIODE—Two diodes in one envelope

TRIODE—Three elements (anode, cathode and grid)

DUO-DIODE-TRIODE—Two diodes and a triode in one envelope

TETRODE—Four elements (anode, cathode and two grids)

PENTODE—Five elements (anode, cathode and three grids)

Radio tube names usually indicate the number of tube elements. Many tubes having more than five elements are in use.

(In radio terminology, the anode is usually called the plate.)

TUBES

GLOW TUBE • PROTECTOR TUBES (For special applications)	GRID GLOW TUBE ★(Gas Triode)	POOL TUBE (Mercury Arc Rectifier)	GRID POOL TUBE • EXCITRON (Mercury Arc Rectifiers)	IGNITRON	GUSETRON	GAS PHOTOTUBE
Illumination, rectification and regulation at low current, low voltage	Controls small amounts of power	Rectification, conversion and control of large amounts of power				•Process and quality control •Detection devices
•Switchboard indicating lights •Control circuit voltage regulators •Protection of supervisory control circuits	Safety control of furnaces	Power for Aluminum, Magnesium, Mining, Electrochemistry, Transportation and Steel. (Ignitrons and Gusetrons are also used in resistance welding control.)				•Pinhole detector •Cutting, winding and printing control
None	Electrostatic (Grid)	None	Electrostatic (Grid)	Resistance ignition	High potential gradient ignition	Light variation
Cold		Pool (usually mercury)				Photoelectric

dio which are not classified above. These in-
pes, Kinescopes, Ballast Tubes and Tuning Eyes.

CHART 1

TYPES OF VACUUM AND GAS-FILLED ELECTRONIC TUBES

CHART 2

SYMBOLS FOR ELECTRONIC TUBE ELEMENTS, VACUUM AND GAS-FILLED ELECTRONIC TUBES, AND ELECTRONIC CIRCUIT ELEMENTS

Compiled by

WESTINGHOUSE ELECTRIC & MFG. CO.

Electronics for the Machine Designer

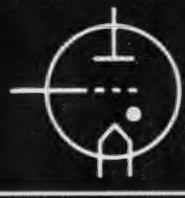
SYMBOLS FOR TUBE ELEMENTS

ENVELOPES		CATHODES		
High Vacuum	Gas Filled	Thermionic (hot)		Cold (including Ionic Heated)
		Direct Heated	Indirectly Heated	
	Located as convenient			

TYPICAL SYMBOLS FOR HIGH VACUUM ELECTRONIC TUBES

Tube Names	KENOTRON		X-RAY
	Direct Heated Cathode	Indirectly Heated Cathode	
Symbol			

TYPICAL SYMBOLS FOR GAS FILLED ELECTRONIC TUBES

Tube Names	RECTIGON • TUNGAR • PHANOTRON	THYRATRON	
		Triode Direct Heated Cathode	Tetrode Indi… Cat…
Symbol			

TYPICAL CIRCUIT SYMBOLS

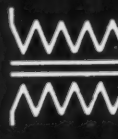
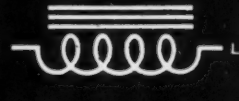
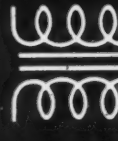
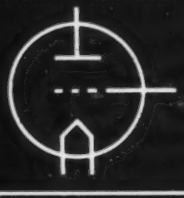
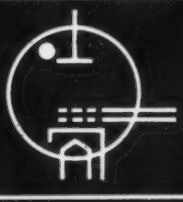
Device:	REACTOR		TRANSFO…
	Iron Core	Air Core	
Industrial Symbol			
Radio Symbol			

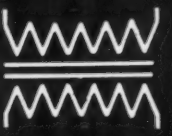
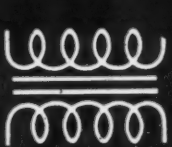
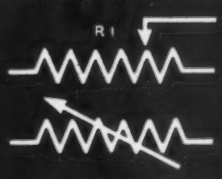
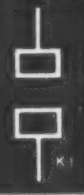
CHART 2

ATHODES (emitters)				COLLECTORS		CONTR	
cluding eated)	Pool	Photo Sensitive	Ionic Heated with Supplementary Heater	Anode (Plate)	Target (X-Ray)	Electrostatic (Grid) (including beam confining or beam forming electrodes)	Electrostati (deflecting, re ing or repelli electrodes)

The above symbols represent specific functions of tube elements. When two or more functions are combined in one element (such as a dy multiplier type photo tubes) the symbols are combined like this, . All symbols can be used in an unlimited variety of combinations for cor

X-RAY	PLIOTRON		CATHODE RAY		MAGN
	Triode with Direct Heated Cathode	Pentode Indirectly Heated Cathode	Electrostatic Control	Electromagnetic Control (magnetic coils added to suit)	Resona (magnetic to s
					

ON	PERMATRON	GLOW TUBE	GRID GLOW TUBE	POOL TUBE
Tetrode Indirectly Heated Cathode	(Magnetic coils added to suit)			(Full Wave)
				

TRANSFORMER	RESISTOR	POTENTIOMETER	CAPACITOR		
	Fixed	Variable	Fixed	Variable	Contact Open when De-energized
					
					

These circuit symbols indicate differences between industrial and radio practice. Symbols that are the same for both are not sho

TUBE ELEMENTS

CONTROL ELECTRODES			SHIELD	COUPLING	RESONATORS (Cavity type)	
Electrostatic (deflecting, reflecting or repelling electrodes)	Resistance Ignitor	Excitor	Internal Envelope	Anode Connected	Single Cavity Envelope	Double Cavity Envelope
	Ignitor	Excitor	External connection			

lement (such as a dynode, used in combinations for complete tubes.

VACUUM TUBES

MAGNETRON	KLYSTRON	RHUMBATRON	VACUUM PHOTOTUBE	
Resonant Type (magnetic coils added to suit)	(Single Cavity)	(Double Cavity)		Multiplier Type

GAS TUBES

POOL TUBE (Full Wave)	GRID POOL TUBE	EXCITRON	IGNITRON	GAS PHOTOTUBE

CIRCUITS

RELAY CONTACT				RELAY COIL	DRY DISK OR METAL RECTIFIER
Contact Open when De-energized	Contact Closed when De-energized	Interlock Open when De-energized	Interlock Closed when De-energized		
CR1	CR1	a CR1	a CR1	CR1	Rectox #1
K1	K1	K1	K1	K	RX1

for both are not shown here.

Converting Electricity into Light

We now turn, finally, to the consideration of converting electricity into light by electronic means. When emitted electrons traveling through the gas-filled space of an electronic tube collide with some of the gas atoms, light is produced. The reason for this is that when a gas atom is hit, some of the electrons in the atom's outer-space shell may be driven to an inner-space shell in the same atom (Fig. 27). When this happens, these electrons absorb a certain specific amount of energy as they are forced to an inner orbit. But they do not keep it long, because almost immediately they return to their original orbits, and in so doing, give off the absorbed energy in the form of wave radiations (Fig. 28).

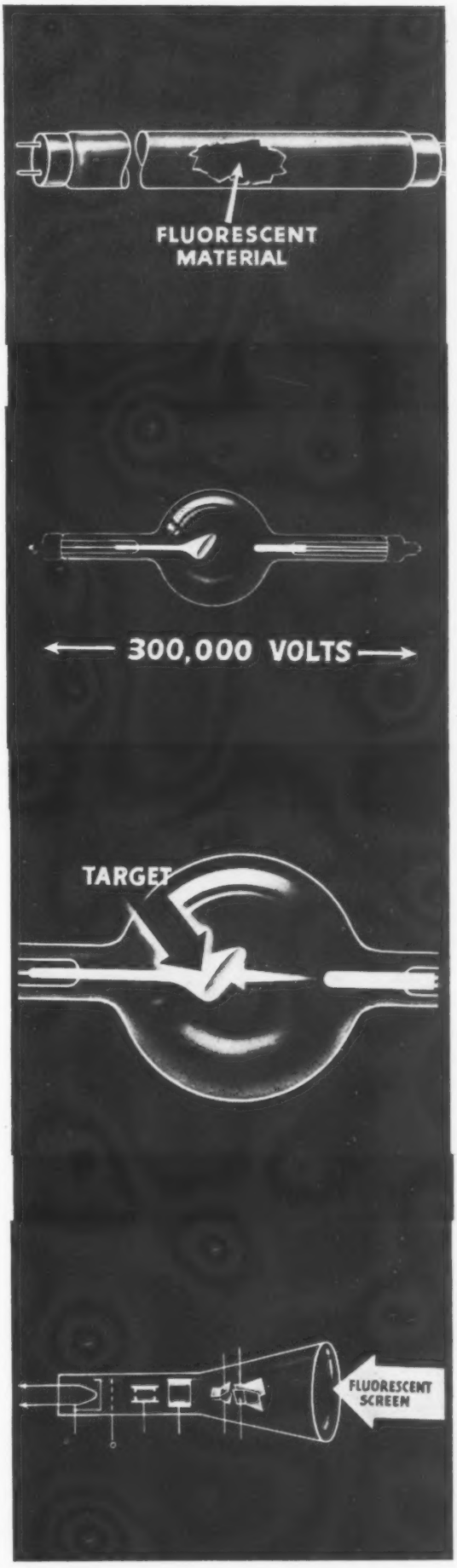
These radiations are usually of a frequency visible to the human eye and of a color dependent upon the kind of gas in the tube. Neon, for instance, gives a reddish hued light; sodium vapor gives a yellowish light. The sodium-vapor lamp is now widely used for highway lighting because of its high luminous efficiency.

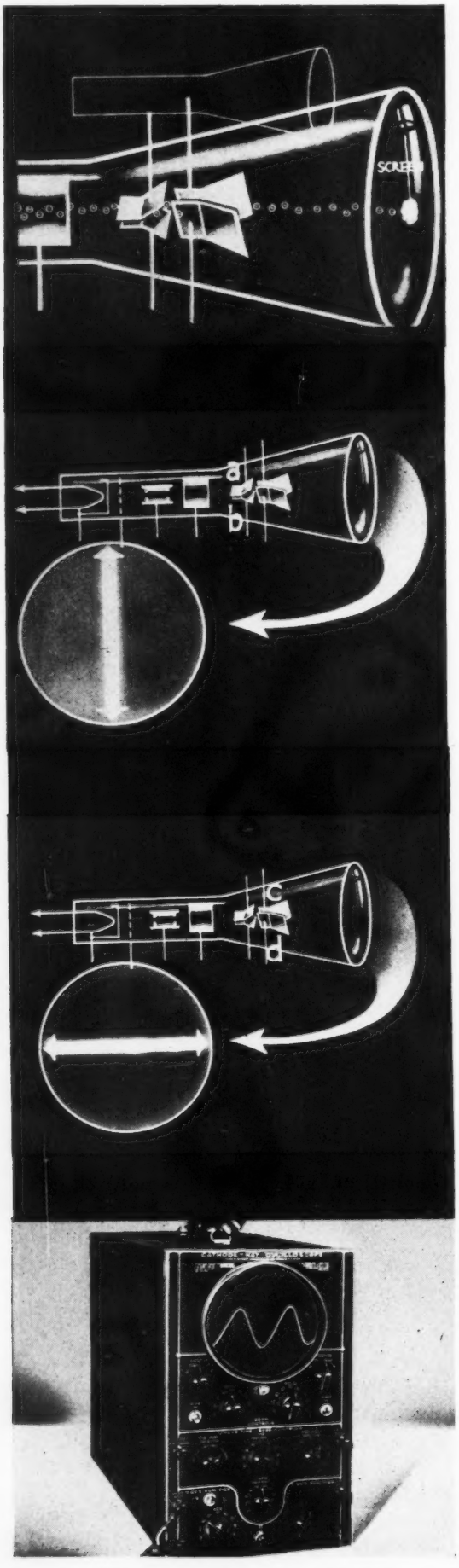
Among the light frequencies produced by mercury is the ultraviolet. This has several characteristics of utmost importance. One of them is a high therapeutic and sterilizing effect. Another characteristic of ultraviolet light is its ability to cause certain materials to fluoresce or give off light. This principle constitutes the foundation of the entire fluorescent lighting industry. The inner surface of a fluorescent lamp glass tube is coated with a fluorescent material containing a small quantity of mercury (Fig. 29). Heated electrodes at the ends of the tube emit initial electrons which ionize the mercury vapor. Ionization, in turn, produces the ultraviolet light which, by impinging upon the coated surface of the tube, causes it to fluoresce and give off visible light.

The X-ray tube, indirectly, also transforms electric current into light and into light images. A potential ranging up to several hundred thousand volts or more is applied to the anode and cathode of a two-element tube (Fig. 30). A cylinder or focussing cap surrounds the cathode of the tube. This concentrates and directs the electron emission toward a small area of the anode, generally called the "target" in this type of tube.

When the directed electron stream hits the target, (Fig. 31), it does so with such tremendous impact that ultra short-wave radiations, known as X-rays, result. These rays have the highly important property of being able to penetrate solid objects. The degree of their penetration for a given voltage varies with the relative densities of the areas within the object. X-ray machines are being increasingly utilized industrially for the inspection of large structural members, such as heavy castings, to locate possible hidden flaws.

Another type of electronic tube which converts electricity into light is the cathode ray tube. Its





elements include an envelope or glass bulb shaped roughly like a megaphone with a fluorescent screen coated on the inside of the large end (Fig. 32). Inside this envelope are a cathode, a control grid, two accelerating anodes, and two sets of deflecting plates.

The cathode, control grid, and accelerating anodes are often referred to as the "electron gun." This gun supplies a beam of electrons, which is directed against the fluorescent screen, producing by its impact there a luminous spot (Fig. 33). This spot can be made to move up and down by impressing varying voltages on vertical deflection plates *a* and *b* (Fig. 34). Lateral movement of the spot can be produced by the placement of varying voltages on horizontal deflecting plates *c* and *d* (Fig. 35). In another type of cathode ray tube, deflection of the beam of electrons is effected by electromagnetic coils rather than electrostatic plates.

The cathode ray tube is the type used in television receiving sets. More important industrially is its use in the cathode ray oscilloscope (Fig. 36), an electronic device that has been successfully used for inspection and testing procedures, in addition to its more common use for electrical analysis.

Summary of Applications of Electronic Devices

It can be seen, then, that there is an extremely wide range of applications to which electronic devices can be applied. But for each specific application that is considered, the advantages offered by electronic devices must be carefully weighed against those afforded by other means. In summing up, we can say that some of the technical advantages peculiar to electronic devices are as follows:

1. They can detect infinitesimally small amounts of power, and amplify them into usable or measurable quantities. Regardless of the ratio of amplification, faithful reproduction can be obtained.
2. They give practically instantaneous response and perfect sensitivity, as compared to the time lag and sensitivity tolerance always present in mechanical devices.
3. They are inherently rectifying.
4. They permit control of the application of power in periods of fractions of a second without the use of an arc-interrupting device. This is true whether handling a fraction of an ampere or thousands of amperes.
5. They can be used to transform light energy into electrical energy, as illustrated by the well-known photo-tube.
6. They have no moving or rotating parts. This makes for less wear, as well as simpler foundation and mounting problems.
7. They can be used to generate waves of energy at any desired frequency. This characteristic is used in producing high-frequency waves for X-rays, internal heating, germ killing, etc.

Novel Rotary Curing Machine for Airplane Blade Fairings

A HUGE machine, 40 feet in diameter, is used in the East Hartford, Conn., plant of the Hamilton Standard Propellers Division of the United Aircraft Corporation for curing propeller blades. This 100-ton rotary curing machine is believed to be completely novel in design and conception.

The huge steel turntable turns on rollers mounted on a concrete foundation. The outer rim of the table is flat, and is divided into forty-two separate slots, each of which is a sector carrying a half-ton mold into which the blade fairing assembly is inserted for curing. Each slot has its individual system of air, steam, water, and electricity, automatically controlled through cam-operated valves and Bristol pressure controllers. Main supply lines are brought in through the center of the turntable by swing joints and slip rings.

The machine cures two sets of twenty-one blades simultaneously. Each mold starts at a loading station, turns until it comes to a gap type hydraulic press, then moves successively through a steam-heating cycle, a water-cooling cycle, and finally to an unloading station half way around the circle. A similar cycle is started and repeated on the other half of the table.

The machine turns intermittently clockwise, advancing one blade sector every twelve minutes, and is activated by a pneumatic ratchet drive from a 14-inch air cylinder connected to the shop's regular compressed air lines. This movement allows a little over four hours for each curing cycle, or half-turn of the table.

The first step in the operation is to coat the inside of the mold with wax, at the loading station, after which the steam in that mold is turned on. A blade, about which a fairing has been built by hand from molded pieces of sponge rubber covered with sheets of uncured ebonite, is then inserted into the mold, which is loosely bolted. The turn of the table carries the mold under one of the two 100-ton Farquhar hydraulic presses, which closes it under pressure. This forces out excess rubber and allows the mold bolts to be tightened.

Fig. 1. This "Merry-go-round," 40 Feet in Diameter, is a Rotary Curing Machine for Propeller-blade Fairings or Cuffs. The Blades are Progressing Clockwise through a Cooling Cycle to an Unloading Station at the Extreme Left

PROPELLER-BLADE CURING MACHINE

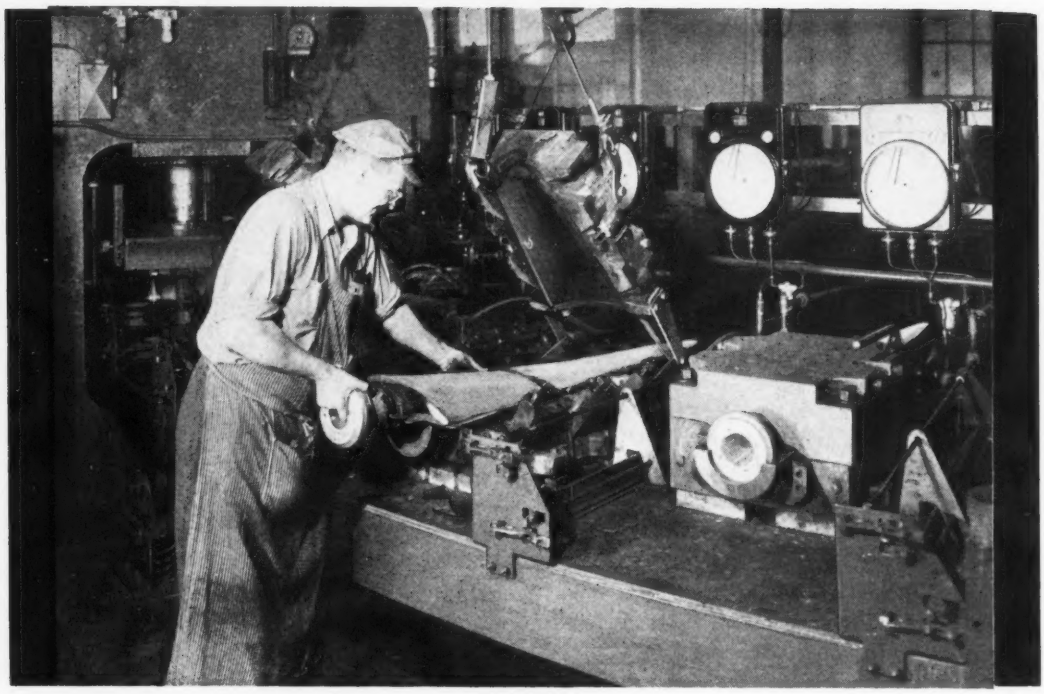


Fig. 2. Unloading a Propeller Blade from the Rotary Curing Machine after it has been Subjected to a Four-hour Treatment for Curing the Rubber Fairing. In the Background is a 100-ton Hydraulic Press through which the New Blade will go after the Mold is Loaded again

After the mold with its blade advances to the next position, a canvas and wool insulation blanket is put over it to conserve heat and protect the workmen. The table then carries the mold by progressive steps about one-third of the way around the circle, completing the heating cycle under steam pressure. At this point, the heat is turned off and refrigerated water is circulated through the mold. Blade and mold are then cooled for a little over an hour until the combination reaches the unloading station 180 degrees from the loading point.

The huge Farquhar presses are among the largest open-side presses ever made. The mountings of the rotary table near the presses are on steel springs, so that there will be a slight "give" to bring the table into contact with the lower platen of the press while the mold is being closed. When the pressure is released, the table rises and clears the platen by about 1/16 inch.

The Interests of Labor and Capital are the Same

BUSINESS recognizes that it is in the same boat with labor and that both depend entirely on the consumer.

Intelligent and informed labor leaders know that everything that contributes to profits and progress—efficient production and distribution, lower costs that permit lower prices, the accumulation of business reserves that make possible improved machinery and methods, and the exploitation of new or improved products—contributes to full employment and increased wages.

The workers employed in most corporations get out of them many times more than the stockholders receive. They have a much larger interest in the preservation and the growth of the enterprise in which they work than have the owners. This fact is not realized generally by the workers.

High wages in most cases are the result of mechanical and managerial efficiency and the effective use of horsepower. They can be achieved and continued only as unit costs of production can be kept sufficiently low to permit making prices low enough to stimulate demand.

Another fact that should be understood is that any gains for particular labor groups that are at the expense of other workers, including farmers, are detrimental to national welfare.—*Stevenson, Jordan & Harrison, Inc.*

Industry Will Find Jobs for Disabled Veterans

Through Many Years of Successful Employment of Physically Handicapped Workers, the Packard Motor Car Co. Has Proved that Industry Can Provide Real Jobs for Disabled Servicemen

As the problem of industry's part in providing employment for returning disabled veterans is becoming more clearly defined, a great deal of interest is evidenced in the results obtained by several large manufacturers who have made it a practice for many years to employ handicapped civilian workers. An outstanding instance is that of the Packard Motor Car Co. This organization has had wide and satisfactory experience in the employment of seriously handicapped workers.

The experience of this organization, as well as that of others who have employed handicapped workers on a fairly large scale, is a matter of great encouragement to disabled servicemen. They do not need to feel that they will become objects of charity, but, on the other hand, can be assured of being able to take their place in civil life on an equal footing with those more fortunate.

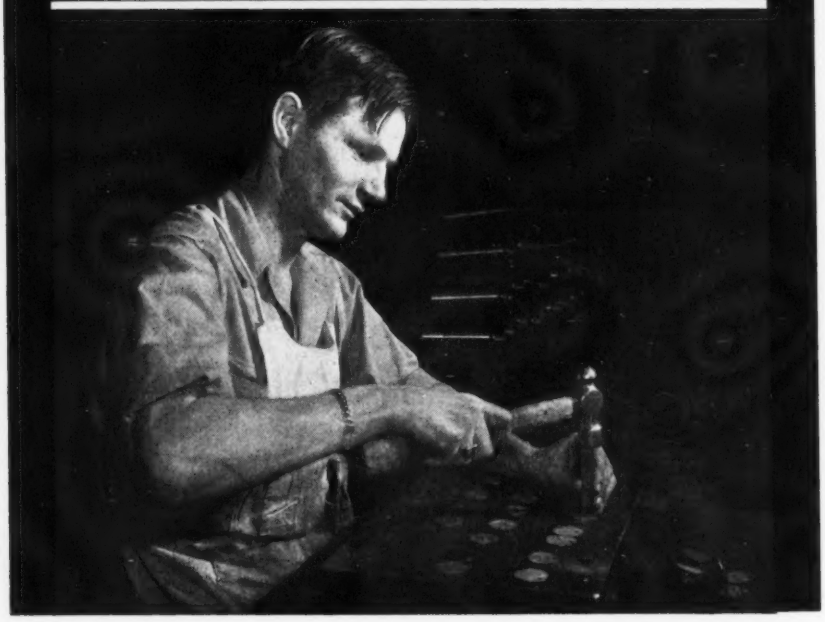
It is also a matter of encouragement to manufacturers who are willing and eager to do their part in this respect in post-war years, but who may have felt that there was no place for workers with severe handicaps in their shops because of the character of the work. The Packard experience will help to convince these manufacturers that disabled workers are capable of performing a great many duties ordinarily thought suitable only for able-bodied men. In the pres-

Infantile Paralysis Robbed Frank Mitchell of the Use of His Legs, but Today He is Principal Inspector of Parts for the Packard-built Rolls-Royce Aircraft Engines. He became Connected with Packard over a Year ago, and, Since then, He has Not Missed a Day at Work nor ever been Late. He Drives His Own Car to Work, Having Designed for it an All-hand Control. Plant Guards Help Him from the Car into His Wheel-chair

JOBS FOR DISABLED VETERANS

Some Years ago, William Smart, a Veteran of the First World War, Lost His Arm in a Punch Press. Here He is Shown Lapping Aircraft Engine Parts on a Revolving Abrasive Wheel. His Attendance Record is Perfect; He has Not Missed a Day from Work since the War began

Ralph H. Robert was in the Southwest Pacific for Thirteen Months. At the Battle of Munda, He was Blown 10 Feet in the Air by a Bomb Explosion, and was in a Hospital Three Months Suffering from Concussion. Before He Enlisted, He was a Hotel Clerk; but Now He is a Machine Operator in the Packard Aircraft Engine Division



During the Invasion of North Africa, a Shell Explosion Blew James Scott into the Air and Tore the Ligaments of His Left Side, Leaving Him Badly Shell-shocked. He Now Fills His Place as a War Worker, Stamping Cylinder Identification Tags in a Quiet Corner of the Plant

ent article, emphasis will be placed on the kind of work that is being done by this class of workers and what their immediate supervisors—their foremen—think of them and their work.

In 182 of the 575 departments in the aircraft and marine engine divisions of the Packard plant in Detroit, there are approximately 13,000 employes, of whom 166 are seriously handicapped physically. Among these are 18 with one arm amputated, 15 with one hand amputated, 20 with one leg amputated, and 4 with one foot amputated. There are 44 badly crippled workers, besides 5 with a crippled arm, foot, or back.

In employing these workers, there is not a great deal of distinction made between them and those who are physically fit, because it has not been found necessary to draw any definite line of demarcation. In the employment office, a separate window is provided for interviewing people with obvious disabilities. When the attendant sees them in the regular line, he merely asks them to come over to this window so that they will not have to wait so long. Here, also, the kind of work suited to their handicap may be more readily selected.

The man in charge of the employment department's "labor grievance" division is especially well informed on the jobs that can be done by workers with one arm, one leg, or some other physical handicap. His advice, therefore, is sought in placing these men in the right jobs. He also handles most of the requests for changes on the part of those who are physically handicapped. Sometimes such a worker feels that he is not able to handle the particular job on which he may have been placed, and in that case, an effort is made to find a more suitable job to which he can be transferred. Obviously, certain jobs can be performed more easily by the physically handicapped than others and the aim is to place the man where he will be most satisfied and where he can do his best work.

Conversation with the foremen in the different departments brings out the fact that the physically handicapped workers in the Packard plant are doing a job of considerable value in the war effort. The accompanying illustrations show a few typical examples of work being done by these men.

What the Packard Foremen Say about These Workers

The clearest conception of what the results have been in the Packard plant may be obtained by quoting from some interviews with department foremen.

A man working in the salvage department lost his hand five years ago. His foreman says: "With the aid of a mechanical hand, he is operating the chip salvage station, and is doing excellent work as a group leader." Another man

Bob King, a Victim of Infantile Paralysis at the Age of Two, is on the Job Every Day in the Aircraft Engine Division of the Packard Plant. His Recreation is Golf. He is the Famous Professional Golfer, Who, Playing on Crutches, Holds the Course Record at the Lexington, Ky., Country Club and at Bob-O-Link, Detroit

whose left arm has been rendered useless by an injury is referred to as "a most excellent inspector." Of a man whose leg has been amputated and of three others who are badly crippled, their foreman says: "The handicapped people in this department are doing an exceptionally good job."

Another man is referred to as "the hardest worker in the whole department—he is always on the job." This man has only one arm; but with a steel hook taking the place of his right hand, he is employed at a lapping machine for aircraft engine parts.

Another case is that of a young man whose left arm is amputated at the shoulder. He had been attending the University of Detroit, where he was studying for the teaching profession. Desiring to have a more definite part in the war effort, he got a job checking and visually inspecting new equipment as it arrives at the receiving dock.

Of another man, who lost his right arm five years ago, his foreman says: "He is very careful and does his work in a painstaking manner; for this reason we give him work that requires particular attention. He is a fine workman." In another case, the foreman's verdict is: "The best workman I have ever had; I would like to have six more just like him."

These quotations could be continued indefinitely, because almost every one of the handicapped men has proved himself not only capable, but conscientious and cooperative. They are good workmen, who are doing a good job in spite of physical handicaps.

The Worker's Own Attitude

It is also of considerable interest to note the attitude of the handicapped workers themselves. A man who was struck with infantile paralysis when he was but four years old and who has never been able to use his legs sits in a wheelchair all day. He is an inspector of small precision parts for the Packard Rolls-Royce aircraft engine. He has a fine record with the organization. "My job is really a pleasure to me," he said; "it is a fine feeling to know that you are doing something to aid the war effort."

Another man, with only one arm, who is in charge of the Packard chip-room and has eight men in his department, gave expression to a thought that must have been the inspiration of many of these handicapped men: "The mental attitude is all-important when you have lost the use of an arm or leg. If you think you are licked, you probably are; if you don't, you are not." This man has a hook arm in place of the one he lost. He says he can do almost anything with it. For example, he can hold a knife in this "hand" when cutting meat, and, for convenience, he uses it as a hammer when he wants to drive nails. No wonder he says, "I believe that anyone can make the best of things if he only tries."

Another worker, with his right leg amputated just below the knee, is an expert machinist and operates practically all types of machine tools. Many of these machines he is able to operate in a sitting position, but if necessary, he can stand on his one good leg for a reasonable period of time.

The outstanding example of a man who "cannot be licked" is Bob King who, besides performing a real job in the plant, is the only professional golfer in the world who plays golf on crutches. When around the plant, he uses both crutches, while around his office he is able to get along with one.

The Mental Attitude is the Important Thing

These brief impressions from the Packard plant indicate more clearly than anything else could do that the mental attitude of the worker himself and of his foreman and other superiors is the most important consideration in this whole matter of employing disabled men. If the employer takes the attitude that these men can do good work, provided they are placed on work suitable to them, that they are not in his plant as a matter of charity, but because, as workers, they perform their work and earn their pay the same as any other worker, then success in the employment of handicapped men is assured. This attitude on the part of the employer, when passed on to the foreman, in turn, creates confidence and self-respect among the workers.

The problem of employing disabled veterans, which to many employers now looms so large, will prove much less of a problem than expected when it is tackled in the simple matter-of-fact manner just described. That it can be done successfully has been proved by years of experience in several cases in American industry.

* * *

Industry Planning for the Future

The Committee for Economic Development, 285 Madison Ave., New York 17, N. Y., has published a booklet entitled "Planning the Future of Your Business." This is a manual intended for industrial employers, and is especially prepared to be of most use to firms with fifty or more employes. The booklet takes up, step by step, six specific factors that require attention in planning for the future, dealing with the executive's part in post-war planning, product planning, markets and sales program, additional manufacturing facilities, employment requirements, and operating funds.

A Proposed Method of Cleaning Ground-In Precision Ball Bearings

By W. B. SPOONER, JR., Consultant
Magnus Chemical Co., Garwood, N. J.

WHERE extreme precision requires that ball-bearing assemblies must be ground-in after assembly, the abrasive used is, of necessity, extremely fine; and the problem of cleaning the finished unit after the operation is a most difficult one, both because of the very finely divided abrasive and of the inaccessible areas inside the assembled bearing. The removal of the lubricant used in the grinding-in operation presents no particular problem, although, of course, it is not possible to use any cleaning material that requires a water rinse; but the removal of the final traces of abrasive has caused a great deal of trouble, since ordinary cleaning materials and methods are not designed to insure the complete removal of solid particles, particularly of such finely divided material.

It was thought that some type of emulsifiable solvent might be used successfully. There is no question but that, if the usual procedure in the use of emulsifiable solvents were followed, the flushing out with water after a dip or the flushing with a mixture of kerosene and emulsifiable cleaner would remove the finest particles of abrasive. As a matter of fact, this treatment did prove satisfactory in so far as cleaning goes, but it was not possible to recommend any treatment that involved water rinsing, since traces of water remaining inside the assembly would cause rust.

However, it seemed as though the emulsifiable solvent method was, at least, a step in the right direction, and further experiments were undertaken. In the course of these tests, it was decided to try a product that is now used for the dispersion of heavy sludge in fuel oil. This material is an oil soluble dispersing agent. It was thought that by mixing this material with kerosene, sufficient dispersion of the very finely divided abrasive might be obtained in the mixture to insure all traces being flushed out of the bearings.

The first test gave satisfactory results, and many checking tests showed that if this mixture of one part dispersing agent with five parts of kerosene was put through the bearing at sufficient velocity, the abrasive would be picked up from all interior parts and removed with the flushing stream.

This method has been used for some time by one maker of ball bearings with satisfactory results. The cleaning operation has been set up along the lines described in the following, but any number of other ways of applying the solution are possible, so long as the velocity of the solution is sufficient to do the job.

In this particular instance, the bearings are rotated inside a horizontal hollow chuck by means of a motor-driven spindle equipped with a hollow conical end which fits over the outside of the bearings. The cleaning solution is pumped through the chuck, thus reaching all parts of the rotating bearing at considerable velocity. The mixture of one part dispersing agent and five parts kerosene does a consistently complete cleaning job. After passing through the chuck, this solution is picked up by another pump and filtered in a small plate-and-frame filter. The solution can be used repeatedly, since all traces of abrasive are removed by the filter and there is no deterioration of the solution in service.

* * *

Machine Tool Shipments and Orders

According to the Tools Division of the War Production Board, the value of machine tool shipments during February, the last month for which statistics are available, totaled $50,150,000. This is a decrease of 11 per cent compared with the value of the shipments in January, which amounted to $56,350,000. The shipments during February were at an annual rate of approximately $600,000,000.

The total of orders received for machine tools during February amounted to $33,512,000, an increase of more than 12 1/2 per cent over the January total. Cancellations totaled $2,057,000, leaving net orders—that is, new orders less cancellations—valued at $31,455,000. This represents an annual rate of new business of approximately $375,000,000.

The unfilled orders remaining on the books of the machine tool builders at the end of February amounted to $162,667,000, representing somewhat over three months production at the rate of shipments during February.

* * *

A motor, generator, or control mechanism that works perfectly at ground level may not operate satisfactorily eight or ten miles up in the air. To test the operation at such heights, Westinghouse engineers have constructed a test chamber by which conditions at 70,000 feet may be duplicated. The temperature can be lowered to minus 67 degrees F. and the pressure to 3/4 pound per square inch. Means are also provided for controlling the humidity.

Grinding to Ten-Thousandths Inch on a High-Production Basis

Methods and Equipment Used for High-Production Grinding of Work that is Held to Size within Tenths of a Thousandth of an Inch—Second of Three Articles

By RALPH PRICE, Chief Designer
Landis Tool Co., Waynesboro, Pa.

SIZING methods and equipment developed and used successfully for precision grinding at high production rates were described in April MACHINERY, page 154. The present article explains conditions that cause or are likely to cause inaccurate grinding, and offers suggestions for avoiding or correcting them.

Inaccuracies in either the dimension or shape of ground work may be due to the condition of the grinding machine, the condition of the work as it comes to the machine, or to unskillful operation of the equipment. Close limits simply cannot be secured on a grinding machine that is not heavily and rigidly built and maintained in the best possible condition.

In sizing by any method where the gage rides the work or surface being ground—whether the grinding is done by hand feeding, power feeding with hand control, or a fully automatic cycle—the accuracy is dependent on a steady responsive feed and a good gage. In sizing by moving the wheel-base against a positive stop, the condition

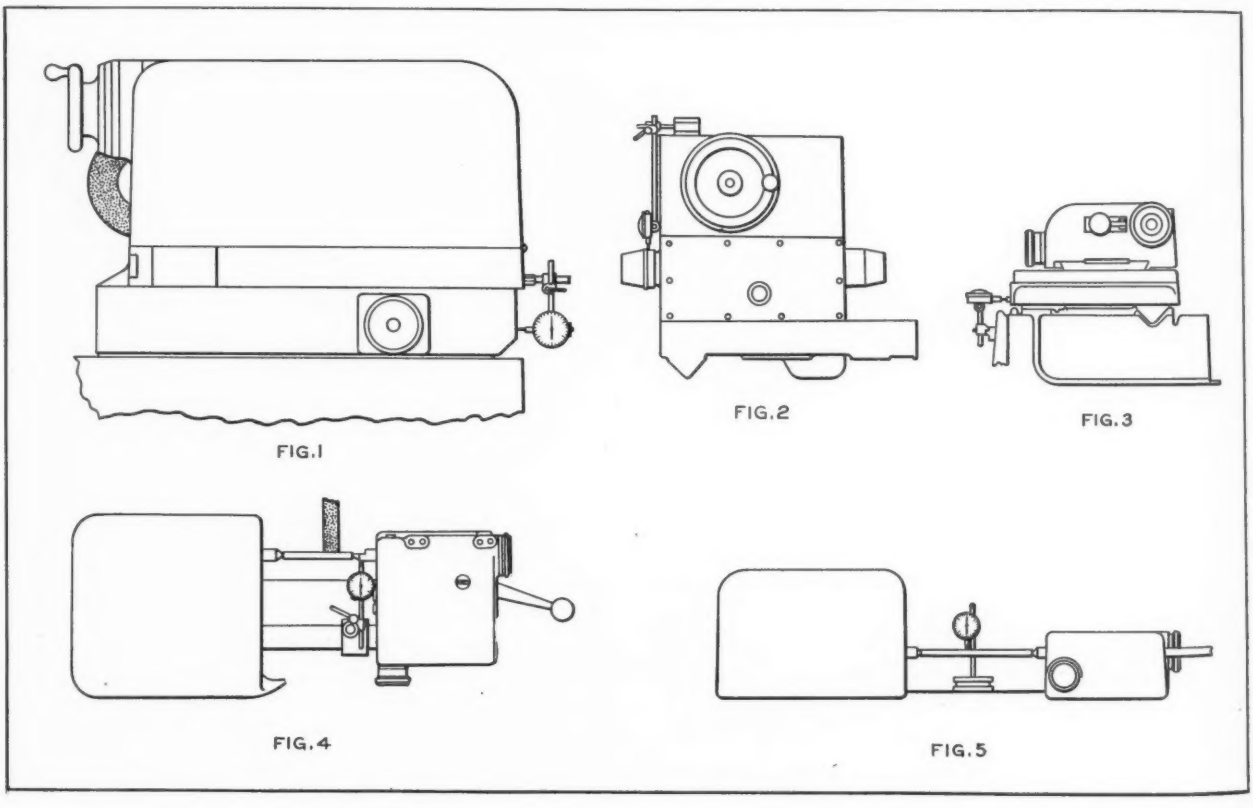


Fig. 1. Method of Using Dial Indicator to Test Over-all Accuracy of Wheel Feed. Fig. 2. Checking Shake in Wheel-spindle Bearings with Dial Indicator. Fig. 3. Using a Dial Indicator to Check Stability of Work-carriage Ways. Fig. 4. Method of Checking Deflection of Work-centers. Fig. 5. Application of Dial Indicator in Checking Run-out Caused by Work Drive

of the machine becomes a much more critical factor in obtaining accurate results.

The most important elements as far as machine condition is concerned are naturally those that affect the position of the grinding wheel and the work. The positioning of the wheel is affected by the condition of the bearing of the wheel-base ways, all elements of the wheel feed, and the condition of the wheel-spindle bearings. The position of the work is affected by the stability of the carriage ways, the condition of the work-head spindles and the work-centers.

The over-all condition of the wheel-base positioning elements can best be checked by mounting an indicator between the wheel-base and the bed. The error shown by the indicator will be doubled on the diameter of the work, so that if a tolerance of 0.0002 inch is to be maintained, the maximum allowable wheel-base variation would be about 0.00005 inch, as this would allow for an accumulation of only 0.00005 inch in all other parts involved. The factors affecting this accuracy of movement are the ways of the wheel-base and the smoothness of the feeding mechanism.

Variation in the positioning accuracy is caused by variation of yielding in the feeding mechanisms due to stresses in shafts, gear teeth, stop-buttons, etc. Equally important is the reacting load set up in the castings or housings that carry the various parts of the feeding mechanism. These deflections vary with changes in the load. The load is caused to vary by irregular feeding or a difference in the rate of feed, tight places in the feeding mechanism itself, or sticky ways which cause a hesitating, jumpy movement. Sticky ways usually result from not having enough or the right kind of lubricant.

The condition of the spindle bearings affects the sizing, because when there is too much clearance, the wheel will not readily spark out, and the dwell after all feed has ceased may grind the part under size. With a close fit, the grinding ceases almost instantly when the wheel feed ceases, and the finish size is more closely controlled by the final position of the wheel.

To test the clearance, remove the wheel-center and the spindle pulley. Mount an indicator reading to ten-thousandths of an inch on top of the wheel-base in contact with the spindle. Lift the spindle by hand and read the clearance on the dial. The method of taking up the looseness, of course, differs, depending upon the machine. The clearance should be maintained as recommended by the manufacturer.

The work-carrying members are fully as important as the wheel-head and feed, as far as accuracy is concerned. While there are no deflections due to moving parts, as on the wheel-base, they must withstand the load due to the pressure of the wheel during grinding.

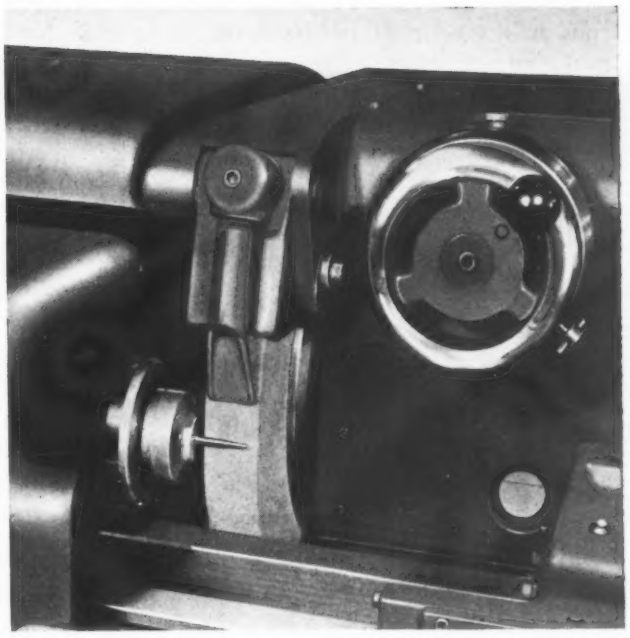


Fig. 6. Grinding Small Accurately Formed Pin on a 4- by 12-inch Plain Grinder with the Work Held in a Collet Chuck. The Grinding Wheel is Fed Straight in, and the Sizing is Automatic

The carriage must be stable. Too much oil on the ways may allow the carriage to shift under wheel pressure, thus causing size variation. Or the carriage ways may be out of line and need rescraping. The condition of the work-carriage can be checked by mounting an indicator on the bed in such a manner that it comes in contact with the edge of the carriage. If the indicator reading shows a change of more than 0.00005 inch in the position of the carriage after each grind, this variation may be the cause of poor sizing.

All work-centers are deflected to some extent under the pressure of the wheel against the work. This should, of course, be kept as small as possible. Do not use long centers, especially long half-centers. In fact, it is best not to use half-centers except for small-diameter work when the wheel pressure is light.

The weaker the center, the greater the deflection will be and the longer the time required for complete sparkout, because of the slight pressure against the work as the center approaches its normal position after the grinding feed has stopped. To observe the deflection of centers, mount a dial indicator on the carriage so that it will come in contact with the center on its straight portion as close to the work as possible. This check will show the amount of deflection, how much time is required for the deflection to normalize, and whether the center returns to the same reading at the end of each grinding operation.

A work-center that is in poor condition or

that has a poor fit in the work or spindle bore is a common cause of poor sizing. Be sure that both the centers and the spindle bores are thoroughly clean, and check the taper fits to see that the centers fit without any shake. Make certain that the center points are in good condition and of a material, such as a cemented carbide, that will remain in good condition under long service. It is also essential that the angle of the center point correspond with the angle of the center in the work. If the work-piece is hardened, the center holes should be cleaned to remove scale.

Shake or too much tension in the footstock spindle may cause inaccuracies. The spindle should be tight enough so that it will just slide in the bearing. Adjust the tension carefully, for too much tension on the footstock center will distort small slender work, while too little tension will allow the pressure of the wheel to force the work out of the centers. In addition to the accuracy required in the machine itself, it is necessary that the work be properly driven by a correctly applied dog or other means.

Often what seems to be size variation is actually out-of-roundness due to a faulty work drive. Grinding torque and the distance from the work-center to the driving dog tend to bend the work. The amount of bowing depends upon the diameter of the work, the distance from the driving dog to the work-center, the radius of contact with the driver, and the torque required to drive the work against the grinding wheel. In grinding slender work, it pays to balance the driving dog, to mount the dog as close to the work-center as possible, and to so arrange the driving pin that it will be in contact with the work-dog on as great a radius as possible.

To determine the amount of bowing of the work, place the work between centers, mount an indicator on the carriage so that it is in contact with the work midway between the ends. Rotate the work slowly by hand. The indicator will show the amount of out-of-roundness and eccentricity with the centers.

One of the most common causes of out-of-parallel or tapered work is overheating, which causes the work to expand unevenly. This may be due to insufficient coolant, cold drafts hitting the work, or too heavy a wheel feed. Taper may also be caused by a wheel that is too soft or too hard.

After a grinding machine has seen considerable service, the ways will be worn more at one place than another. Then if the wheel is dressed at a point other than the grinding position, taper may result. The cure is either to put the ways into condition, or, if possible, to dress the wheel at the grinding position.

If the wheel is allowed to pass off the work at the end of the traverse, the unit pressure between work and wheel will be greatly increased and the ends of the work will be ground to a taper. Often, size variation is caused by allowing insufficient time for a complete sparkout. This can be determined in the same way as was described for testing the work-centers for deflection.

It is important to have enough work-rests to keep the work from bending under the pressure of the wheel or the centers. It is equally important to have the work-rests properly adjusted. If they are too loose, the work may be ground barrel-shaped; on the other hand, if they are too tight, they may force the work into the wheel, causing it to be ground concave.

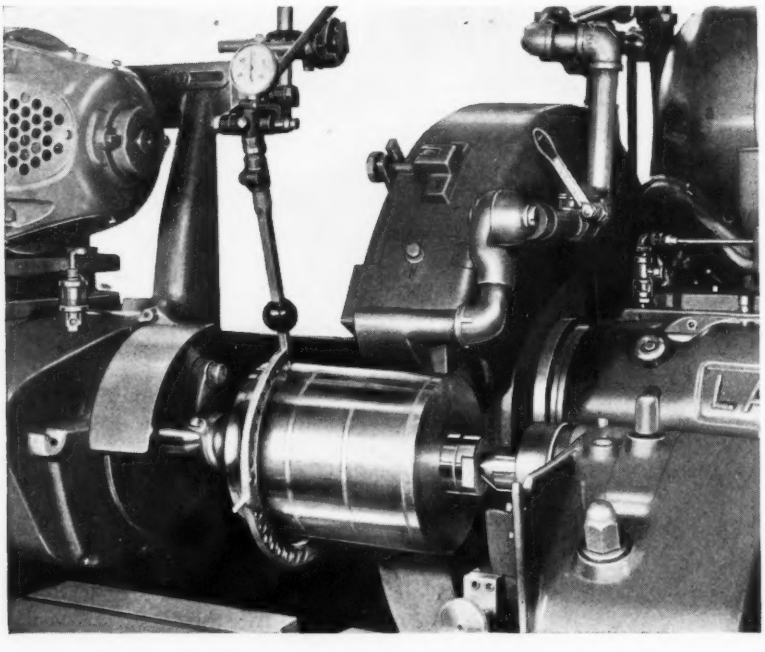


Fig. 7. Grinding Outside of Roller-bearing Races on a 14- by 18-inch Plain Grinder. Three Races are Held on an Arbor, the Work is Traverse Ground, the Wheel Fed by Hand, and a Visual Sizing Gage is Used

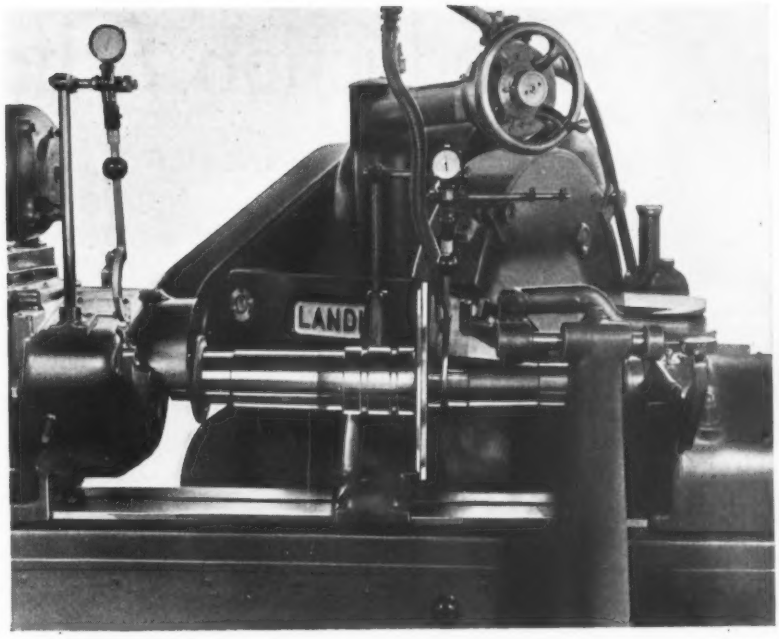


Fig. 8. Grinding Cylindrical Surface and Adjoining Face on a Plain 14- by 36-inch Grinder with the Wheel Set at an Angle and Mounted on Right-hand Side of Spindle. The Wheel is Fed in Automatically, and a Visual Sizing Gage is Used to Permit Manual Interruption of Cut when Work is Ground to Size

Even if the work is of too large a diameter to be bowed by excessive pressure of the centers, the ends of the work may be tapered, due to the fact that the friction causes the ends of the work to overheat, expand, and so present to the wheel too large a diameter.

A cause of under-size work that may occur during the first hour or so of operation of the machine at the beginning of a shift is, we find, due to the heating of the machine, which causes varying expansion in the elements of the machine. After the heating spreads generally throughout the machine, the change due to this expansion is reduced and the variation in size from this cause almost disappears. Since this change is gradual and reasonably uniform, it can readily be compensated for by changes in the setting of the feed handwheel. This compensation is, of course, not difficult, and size accuracy of several "tenths" can usually be maintained in spite of the heating, provided all other machine conditions are right.

Are We Making the Best Use of Our Manpower?

MANY manufacturers are not taking the talk of manpower shortage as seriously as some Government officials are, for the simple reason that they know that there is an enormous waste of manpower both in governmental offices and in industry. It is felt that there is no need for the large number of young, able-bodied men, both in uniform and in civilian clothes, who are traveling around the country telling manufacturers how they should do their jobs. It is further believed that a great deal of manpower could be released by reducing the number of reports that are being made to various governmental agencies. This would save manpower at both ends, both in manufacturing offices and in Government bureaus. The large number of regulations, many of them couched in unintelligible legal language, that emanate from Washington indicate that there are too many people engaged in bureaucratic efforts.

Then, in industry itself, the greatest efficiency has not yet been reached. In some instances, union influence prevents workers from achieving their best. In other cases, the best results are not obtained because the workers do not trust management as regards the permanency of piecework rates. Some workers hold back in their efforts because they fear that if they did their best, piecework rates would be cut.

Workers in Navy Yards and Arsenals recruited from private industry are reported to feel that the pace in the Government organizations is slower than it need be. Add to this the deliberate stoppage of work through strikes in war production plants; this is equivalent to a serious waste of manpower.

All this makes it appear that we are not making anywhere nearly full use of the manpower that we have. The first steps to be taken should be to make sure that every man is engaged in work that is truly essential to the war effort. Then we should see to it that no obstacles are put in the way of making full use of every man's ability and willingness to work.

Production Schedules Met by Sy

Comprehensive Survey of Causes of Motor Failure, together with Definite Instructions on the Steps to be Taken to Avoid Them—Second of Two Articles

THE first article on this subject, published in April MACHINERY, outlined a typical motor-maintenance schedule, and discussed factors affecting the operation of bearings, and the checking of the air gap. Trouble correction charts for alternating-current motors were also given. In the present article, methods of cleaning motors, the testing of insulation, and the maintenance of direct-current motors will be reviewed.

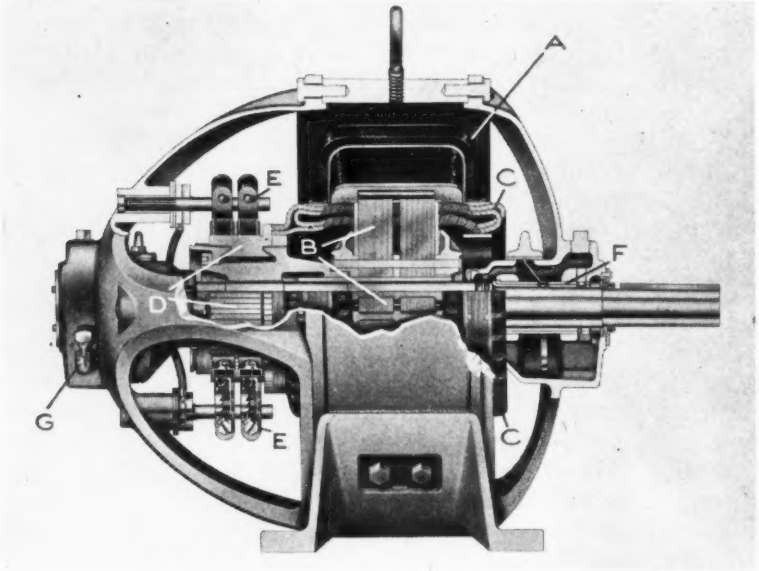
Where coupled type motors are used, the couplings require regular inspection. Faulty alignment in a solid coupling is reflected in bearing trouble and vibration. Make sure that all dowel-pins are in correct position, and check the faces of the couplings with a feeler gage after the bolts have been removed. Shift the motor position to make the faces of the two half-couplings parallel.

Although flexible couplings will often operate under considerable misalignment without causing trouble, the two halves should be checked with a steel scale to make sure that they are in as close alignment as possible. Any misalignment means increased wear on the pins, fingers, or leather disks, whichever may be used. Special type flexible couplings should be checked according to the manufacturer's instructions.

The electrical conductors in a motor are separated from the magnetic circuit and from the mechanical assembly by materials generally grouped under the term "insulation." Insulation is also used in commutators to separate the bars from each other, and in coils to insulate individual turns. It is important that the insulation be maintained so as to function as a separator between the copper coils in the motor and the mechanical assembly. Regardless of the class of insulation used, remember that electrical insulation materials are non-conductors only when clean and dry.

The importance of keeping electrical equipment clean and dry is always worth stressing. Accumulations of dust and dirt not only contribute to insulation breakdown, but they operate to increase the motor temperature through restrictions of ventilation. Dust and dirt are effectively removed with compressed air at about 50 pounds pressure. Do not direct compressed air against the insulation until certain that it is free from any moisture that may have accumulated in the air line from condensation. Too great an air pressure may loosen the binding tape or injure the insulation by sand-blasting with the abrasive dirt which is nearly always present. It may not be possible to remove all dust and dirt with compressed air. If the accumulation of dirt contains oil or grease, a solvent will usually be required to remove it.

There are three types of solvents in general



Cutaway View of Direct-current Motor: A, Field Coils; B, Armature; C, Armature Coils; D, Commutator; E, Brush Rigging; F, Sleeve Bearing; G, Oil Overflow and Filler Plug

Systematic Motor Maintenance

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and W. W. McCULLOUGH, Maintenance Engineer
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use for this purpose. These are petroleum distillates, such as Stoddard solvent or cleaners' naphtha, carbon tetrachloride, and a mixture of the two. The petroleum distillates are the solvents having the least corrosive action on insulation varnishes, and for that reason, where conditions permit, are preferable to the others. The Stoddard type solvent, produced by all the major oil companies, which has a minimum flash point of 100 degrees F., minimizes the fire hazard, and should be used in preference to gasoline or benzine. Nevertheless, in using this solvent, every precaution should be taken to prevent fires or explosions.

When this type of solvent will not clean the apparatus properly, a mixture of carbon tetrachloride and the solvent may be used. A mixture of 50 per cent carbon tetrachloride and 50 per cent Stoddard solvent is non-flammable, but the vapors, mixed with a certain proportion of air, are explosive. In extreme cases, it may be necessary to use straight carbon tetrachloride; however, the toxic effect of this material on the operator is a factor that must be taken into consideration.

Carbon tetrachloride is more corrosive than petroleum solvents, and it evaporates much more rapidly. For this reason, the residue of carbon tetrachloride should be removed with a petroleum solvent. This will prevent corrosion later.

Before any solvent is used, be sure that there is good ventilation and minimum fire risk. Do not let the workers' clothing become saturated with the solvent. Always have fire extinguishers of the carbon tetrachloride type handy. If a hose is used to spray either cleaning solution or varnish, make sure that the nozzle is grounded. Workmen should be guarded against breathing the fumes of carbon tetrachloride, and they should be under the close observation of someone familiar with artificial respiration. Where conditions are particularly bad, such as in pits, gas masks should be worn.

The time to apply varnish treatment is after the motor has been thoroughly cleaned with a solvent. Use a baking varnish recommended by the supplier for the particular conditions encountered. Two dips and bakes may be sufficient for normal conditions, while for extreme conditions of moisture and corrosive gases, four dips and bakes may be required. One or two additional coats of red synthetic enamel may be justified under extreme conditions.

Dry the motor in an oven before dipping it in varnish. Electric or steam heat is the safest and most convenient medium to use. Make sure that suitable temperature control is provided and that it is effective, so as to prevent injury to the insulation. Maximum safe dry-out temperature is 115 degrees C. (239 degrees F.)

To Keep a Motor Clean, a Suction Hose or an Air Line is Useful. When the Dirt Contains Oil or Grease, Additional Cleaning Solvents are Usually Found Necessary

The baking temperature for the varnish and the length of the baking period will depend on the type of varnish used.

Insulation Testing Determines Comparative Conditions

Insulation tests are made to determine the condition of the insulation rather than its quality. While special conditions may justify dielectric tests, over-potential tests, high-frequency tests, or dielectric power factor tests, a test to determine the insulation resistance is generally all that is required in maintenance work. Use Class B insulation (mica, asbestos, fiber glass, and similar inorganic materials in built-up form with organic binding substances) for motors whose record shows breakdowns resulting from operation at elevated temperatures.

The most convenient way to read insulation resistance is with a Megger. The 500-volt type is generally used. A higher voltage Megger may damage low-voltage insulation. Remember that the readings are valuable only from a comparative standpoint, and that they vary greatly with the temperature of the apparatus. A safe general rule is that the insulation resistance should be approximately one megohm for each 1000 volts of operating voltage, with one megohm as a minimum.

Totally enclosed motors and totally enclosed fan-cooled motors have the frames sealed so as to exclude the outside air. They are well protected against the admission of abrasive dirt and metallic particles that shorten the life of insulation in open motors. For enclosed motors there are two points to observe:

First, see that all exposed joints in the motor frame and brackets are tight. Use a water-resistant grease in the bracket fits, if the motor is dismantled for any reason. This will help to prevent accumulation of water in the bottom of the motor frame. Second, make sure that the motor is provided with a drain plug or drain pipe at the bottom of the frame, so that any accumulated water can be removed before it causes trouble.

Periodic Cleaning Prevents Dust and Dirt from Getting into the Motor Windings

Proper Method of Cleaning and Surfacing Brushes is to Place Sandpaper under Brush, Flat against the Commutator Surface. Several Passes of Sandpaper should be Enough, Depending on Brush Condition

Direct-Current Motor Repair

Direct-current motors add the commutator and its current-collecting details to the general maintenance problem. The armature is the heart of the direct-current motor. Through it flows the main-line current, and if the machine is overloaded, the armature is the first to give evidence of distress.

In dismantling a direct-current motor for periodic overhauling, the following points should be observed. Do not roll the armature on the floor; a coil may be injured or the steel banding wire may be nicked. Support or lift the armature only by its shaft, if possible. Never allow the weight of the armature to rest on the commutator or on the coils. Inspect the coils carefully to see that they are tight and, where necessary, replace the wedges.

Replace any bands that may be loose. As far

as possible, duplicate the banding originally furnished by the manufacturer. Do not change the material in the banding wire, the diameter of the banding wire, or the width or position of the band. Increasing the band width may cause heavy currents in the bands sufficient to overheat and melt the solder.

Only experienced workmen should tighten loose commutators. If the commutator bars are tight, they will give out a clear, bell-like ring when tapped lightly with a small hammer. If the commutator does not ring, but gives out a flat sound when struck, the front vee should be tightened.

The exposed portion of the front mica V-ring is normally a catch-all for oil and dirt. This section should be cleaned and protected with a layer of surgical tape and twine to prevent flashovers and breakdown to ground. Red synthetic enamel will give a smooth finish, resistant to oil and carbon dust.

Maintenance of Brushes

Check the brush rigging carefully. Most brush-holders in use today are of the box type, and the brush-holder should be replaced when the inside broached section is worn. The brushes themselves must fit properly—not so tightly as to stick, and not so loosely as to shift position when running. Make sure that the grade used is correct for the application, in accordance with the advice of the manufacturer of the motor. See that the fit of the brush on the commutator extends across the entire face of the brush.

The spring tension on the brushes should be uniform, so as to prevent selective action. The correct pressure will vary with the design of the machine, and adjustments should follow the recommendation of the manufacturer. The brushes should be staggered in pairs of arms to prevent grooving of the commutator. Brush shunts should be kept tight and free from excessive corrosion, so that the current will be uniformly distributed to the brushes. Under bad conditions of corrosive atmosphere, the shunts can be protected by dipping in melted paraffin or synthetic red enamel, or they can be covered with woven cotton tubing.

Resurfacing of the commutator should be done in a lathe or with a grinding rig. A hand-stone should be used only as an emergency, as it is impossible to obtain a true surface with it. Practically all up-to-date direct-current motors have under-cut mica in the commutators. This undercutting should be kept 1/16 inch deep.

Lubricating Gearmotor Units

A gearmotor is a self-contained drive made up of a ball-bearing motor and a speed-reducing gear unit. It is designed to take advantage of the electrical efficiency of the high-speed motor and the transmission efficiency of accurately cut and properly designed gears.

Suggestions already given apply to the motor element of the gearmotor unit. Front-end motor bearings are generally grease-lubricated and require the same attention as in standard ball-bearing motors. Rear bushings, gear-box bearings, and the gears themselves are almost always splash-lubricated from the same oil supply reservoir in the lower section of the gear unit. Oil seals at each bearing prevent oil leakage into the motor windings and out along the driving shaft. The precision-cut gears demand carefully selected lubricating oils. Use only top-grade oils of the viscosity called for by the manufacturer of the gearmotor. In ordering these oils, give full particulars as to type of units and operating conditions.

The areas of contact on gear teeth are relatively small, and the pressures produced in transmitting the loads are relatively large. It is essential to provide a film of lubricant of sufficient strength to withstand the localized pressure during the period of contact. The peripheral speed of the gears governs the period of tooth contact and determines the time during which the film must withstand the pressures. When speeds are high, the time is very short, the loads are usually light, and a comparatively light-bodied lubricating oil can be used. When speeds are low and the loads heavy, the contact time is considerably longer and a heavier-bodied oil should be used.

To Assure Proper Maintenance and Prevent Sparking, This Tool Under-cuts the Mica 1/16 Inch below the Surface of the Faster Wearing Copper Commutator Bars on a Direct-current Motor

Trouble Correction Chart for Direct-Current Motors

Trouble	Cause	What to Do
Fails to Start	Circuit not complete	Check to see if switch is open or leads broken.
	Brushes not down on commutator; held up by brush springs	Brushes worn out; need replacement.
	Brushes stuck in holders	Remove and sand, clean up brush boxes.
	Armature locked by frozen bearings in motor or main drive	Remove brackets and replace bearings or recondition old bearings if inspection makes possible.
	Power off	Check line connections to starter with light. Check contacts in starter.
Motor Starts, Then Stops and Reverses Direction of Rotation	Reverse polarity of generator that supplies power	Check generating unit for cause of changing polarity.
	Shunt and series fields bucking each other	Reconnect either the shunt or series field so as to correct the polarity. Then connect armature leads for desired direction of rotation. The fields can be tried separately to determine the direction of rotation individually, and connected so both give same rotation.
Motor Does Not Come up to Rated Speed	Overload	Check bearing to see if in first-class condition with correct lubrication. Check driven load for excessive load or friction.
	Starting resistance not all out	Check starting to see if mechanically and electrically in correct condition.
	Voltage low	Measure voltage with meter and check with motor nameplate.
	Short circuit in armature windings or between bars	Inspect commutator for blackened bars and burned adjacent bars. Inspect windings for burned coils or wedges.
	Starting heavy load with very weak field	Check full-field relay and possibilities of full-field setting of the field rheostat.
	Motor off neutral	Check for factory setting of brush rigging or test motor for true neutral setting.
	Motor cold	Increase load on motor so as to increase its temperature, or add field rheostat to set speed.
Motor Runs Too Fast	Voltage above rated	Correct voltage or get recommended change in air gap from manufacturer.
	Load too light	Increase load or install fixed resistance in armature circuit.
	Shunt field coil shorted	Install new coil.
	Shunt field coil reversed	Reconnect coil leads in reverse.
	Series coil reversed	Reconnect coil leads in reverse.
	Series field coil shorted	Install new or repaired coil.
	Neutral setting shifted off neutral	Reset to neutral by checking factory setting mark or testing for neutral.
	Too much resistance in field circuit. Part of shunt field rheostat may be cut in	Measure voltage across field and check with nameplate rating.
	Motor ventilation restricted, causing hot shunt field	Hot field is high in resistance. Check causes for hot field, in order to restore normal shunt field current.
Motor Gaining Speed Steadily, and Increasing Load Does Not Slow it Down	Unstable speed load regulation	Inspect motor to see if off neutral. Check series field to determine shorted turns. See if series field has a shunt around the series circuit that can be removed.
	Reversed field coil shunt or series	Test with compass and reconnect coil.
	Too strong a commutating pole or commutating pole air gap too small	Check with factory for recommended change in coils or air gap.

Trouble Correction Chart for Direct-Current Motors—(Continued)

Trouble	Cause	What to Do
Motor Runs Too Slow Continuously	Voltage below rated	Measure voltage and try to correct to value on motor nameplate.
	Overload	Check bearings of motors and the drive to see if in first-class condition. Check for excessive friction in drive.
	Motor operates cold	Motor may run 20 per cent slow due to light load. Install smaller motor, increase load, or install partial covers to increase heating.
	Neutral setting shifted	Check for factory setting of brush rigging or test for true neutral setting.
	Armature has shorted coils or commutator bars	Remove armature to repair shop and put in first-class condition.
Motor Overheats or Runs Hot	Overloaded and draws 25 per cent to 50 per cent more current than rated	Reduce load by reducing speed of gearing in the drive or load on the drive.
	Voltage above rated	Motor runs drive above rated speed, requiring excessive horsepower. Reduce voltage to nameplate rating.
	Inadequately ventilated	Location of motor should be changed, or restricting surroundings removed. Covers used for protection are too restricting of ventilating air and should be modified or removed. Open motors cannot be totally enclosed for continuous operation.
	Draws excessive current due to shorted coil	Repair armature coils or install new coil.
	Grounds in armature, such as two grounds which constitute a short	Locate grounds and repair or rewind with new set of coils.
	Armature rubs pole faces due to off-center rotor, causing friction and excessive current	Check brackets or pedestals to center rotor and determine condition of bearing wear for bearing replacement.
Hot Armature	Core hot in one spot, indicating shorted punchings and high iron loss	Sometimes full slot metal wedges have been used for balancing. These should be removed and other means of balancing investigated.
	Punchings uninsulated Punchings have been turned or band grooves machined in the core. Machined slots	No-load running of motor will show hot core and high no-load armature current. Replace core and rewind armature. If necessary to add band grooves, grind into core. Check temperature on core with thermometer, not to exceed 90 degrees C.
Hot Commutator	Brush tension too high, causing overload	Limit pressure to 2 to 2 1/2 lbs. per sq. in. Check brush density and limit to density recommended by the brush manufacturer.
	Brushes off neutral	Reset neutral.
	Brush grade too abrasive	Get recommendation from manufacturer.
	Shorted bars	Investigate commutator mica and under-cutting and repair.
	Hot core and coils that transmit heat to commutator	Check temperature of commutator with thermometer to see that total temperature does not exceed ambient plus 55 degrees C. rise, total not to exceed 105 degrees C.
	Inadequate ventilation	Check as for hot motor.
Hot Fields	Voltage too high	Check with meter and thermometer and correct voltage to nameplate value.
	Shorted turns or grounded turns	Repair or replace with new coil.
	Resistance of each coil not the same	Check each individual coil for equal resistance to be within 10 per cent, and if one coil is too low, replace coil.
	Inadequate ventilation	Check as for hot motor.
	Coil not large enough to radiate its loss wattage	Replace all coils if room is available in motor.
	Overheating deteriorates insulation and shortens life of the motor	

Trouble Correction Chart for Direct-Current Motors—(Continued)

Trouble	Cause	What to Do
Motor Vibrates and Indicates Unbalance	Armature out of balance	Remove and statically balance or balance in dynamic balancing machine.
	Misalignment	Realign.
	Loose or eccentric pulley	Tighten pulley on shaft or correct eccentric pulley.
	Belt or chain whip	Adjust belt tension.
	Mismating of gear and pinion	Recut, realign, or replace parts.
	Unbalance in coupling	Rebalance coupling.
	Bent shaft	Replace or straighten shaft.
	Foundation inadequate	Stiffen mounting members.
	Motor loosely mounted	Tighten holding down bolts.
	Motor feet uneven	Add shims under foot pads to mount each foot tight.
Motor Sparks at Brushes or Does Not Commutate	Neutral setting not true neutral	Check and set on factory setting or test for true neutral.
	Commutator rough	Grind and roll edge of each bar.
	Commutator eccentric	Turn and grind commutator.
	Mica high, not under-cut	Under-cut mica.
	Commutating pole strength too great, causing over compensation, or strength too weak, causing under compensation	Check with manufacturer for correct change in air gap or new coils for the commutating coils.
	Shorted commutating pole turns	Repair coils or install new coils.
	Shorted armature coils on commutator bars	Repair armature by putting into first-class condition.
	Open circuited coils	Same as above.
	Poor soldered connections to commutator bars	Resolder with proper alloy of tin solder.
	High bar or loose bar in commutator at high speeds	Inspect commutator nut or bolts and retighten; re-turn and grind commutator face.
	Brush grade wrong type Brush pressure too light Current density excessive Brushes stuck in holders Brushes shunt loose	See section on Maintenance of Brushes in article.
	Brushes chatter due to dirty film on commutator	Resurface commutator face and check for change in brushes.
	Vibration	Eliminate cause of vibration by checking mounting and balance of rotor.

See that the oil level marked for each gear-motor unit is maintained. For normal operating conditions, drain the oil reservoir in the lower section of the gear-case once a year and refill with new oil.

Proper Motor Maintenance an Important Aid in War Effort

Proper maintenance, as outlined in the foregoing, is important even in normal times. In these times, when the war effort is demanding most of our critical materials, our manufacturing facilities, and our manpower, the importance of an adequate maintenance program cannot be overstressed. Such a program will do much to maintain peak operating efficiency and make existing critical materials last for the duration of the war.

Rolling a Generator Rotor Journal Instead of Grinding

At the General Electric Co.'s Pittsfield Works, the grinding of the journals of a 2500-pound generator rotor would have required a special-purpose grinding machine. A machine operator suggested that this work could be done by rolling or burnishing instead of by grinding, using methods employed in a locomotive shop where he had served his apprenticeship. He devised a simple rolling tool for the job. The hardened roller produces a dense and smooth surface, and the journal is rolled or burnished in the same lathe in which it is turned. Because the shaft is kept on the same centers for both the turning and rolling operations, it is comparatively easy to keep all diameters concentric. The run-out on the diameter does not exceed 0.0002 inch.

Trouble Correction Chart for Direct-Current Motors—(Continued)

Trouble	Cause	What to Do
Brush Wear Excessive	Brushes too soft	Blow dust from motor and replace brushes with a changed grade as recommended by manufacturer.
	Commutator rough	Grind commutator face.
	Abrasive dust in ventilating air	Reface brushes and correct condition by protecting motor.
	Off neutral setting	Recheck factory neutral or test for true neutral.
	Bad commutation	See corrections for commutation.
	High, low, or loose bar	Retighten commutator motor bolts and resurface commutator.
	Brush tension excessive	Adjust spring pressure not to exceed 2 pounds per square inch.
	Electrical wear due to breakdown of copper oxide-carbon film normally present on commutator face	Resurface brush faces and commutator face.
	Threading and grooving	Same as above.
	Oil or grease from atmosphere or bearings	Correct oil condition and surface brush faces and commutator.
	Weak acid and moisture-laden atmosphere	Protect motor by changing ventilating air, or use enclosed motor.
Motor Noisy	Brush singing	Check brush angle and commutator coating; resurface commutator.
	Brush chatter	Resurface commutator and brush face.
	Motor loosely mounted	Tighten foundation bolts.
	Foundation hollow and acts as sounding board	Coat under side with sound-proofing material.
	Strained frame	Shim motor feet for equal mounting.
	Armature punchings loose	Replace core on armature.
	Armature rubs pole faces	Recenter by replacing bearings or relocating brackets or pedestals.
	Magnetic hum	Refer to manufacturer.
	Belt slap or pounding	Check condition of belt and change belt tension.
	Excessive current load	May not cause overheating, but check chart for correction of shorted or ground coils.
	Mechanical vibration	Check chart for causes of vibration.
	Noisy bearings	Check alignment, loading of bearings, lubrication and get recommendation of manufacturer.

Carbide Prolongs the Life of Core-Boxes

In an Ohio foundry, aluminum core-boxes made in halves and held together by clamps are extensively used. After the box has been filled with core sand and the sand rammed into the box, the latter is rubbed over the bench top to smooth off the bottom. The rubbing over the bench top covered with highly abrasive core sand quickly wears away the bottom of the boxes unevenly, the boxes lasting for only about 1500 cores.

The foundry secured from the Carboloy Company some fishpole guide rings made from cemented carbide. These rings are made to withstand the wearing action of fishing wire and fish-lines. They were attached to the bottoms of the core-boxes, so that the hard abrasion-resisting rings, rather than the comparatively soft aluminum metal, took the wear when the boxes were slid along.

The result has been a big saving in the time previously lost repairing the boxes. The carbide wearproofed boxes now produce over 9000 cores before overhauling is necessary.

* * *

British Gear Manufacturers Organize

The gear manufacturers in Great Britain have formed an organization known as the British Gear Manufacturers Association. Headquarters have been established at 2 Caxton St., Westminster, London. The Association will doubtless carry on work similar to that of the American Gear Manufacturers Association.

Drilling Navy Fighter Plane Engine Mounts

By WILLIAM J. HOFFMAN
Chief of Tool Design
Grumman Aircraft Engineering Corporation

THE building of the engine mount for the Grumman navy fighter plane introduced several interesting problems. An unusual arrangement for performing the drilling operations is illustrated and described in this article. The engine mount is of welded construction. After the various welding operations have been performed, the mount is placed on a machine built especially for drilling, tapping, and spot-facing the attachment lugs.

As shown in Fig. 1, this machine consists of a cast-iron base and a heavy pedestal to which a Leland-Gifford back-geared eight-speed drill head is attached. The drill head is mounted on a large-sized Timken bearing which allows it to rotate through 360 degrees. Above this bearing is a gear train and a rack-operated carriage set in gibs, which allows a radial adjustment of the drill head, so that drilling, tapping, and spot-facing can be done on both the inner and outer bolt circles.

Below this carriage is a circular plate to which are attached three sliding plates fitted with slip bushings for drilling and tapping two sets of

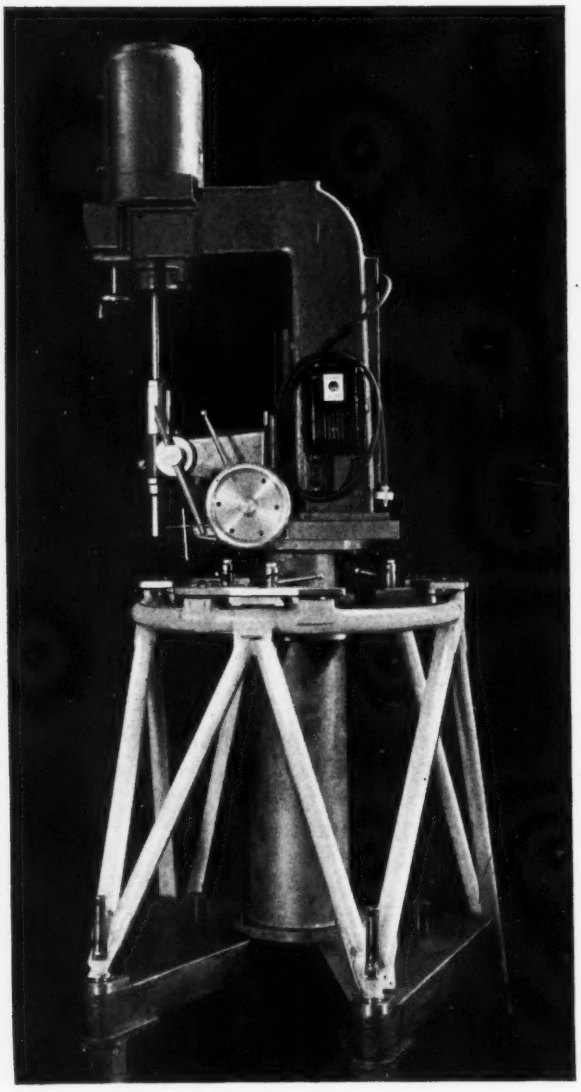


Fig. 1. A Leland-Gifford Drill Head Attached to a Heavy Pedestal, Mounted on a Cast-iron Base, for Drilling, Tapping, and Spot-facing an Engine Mount

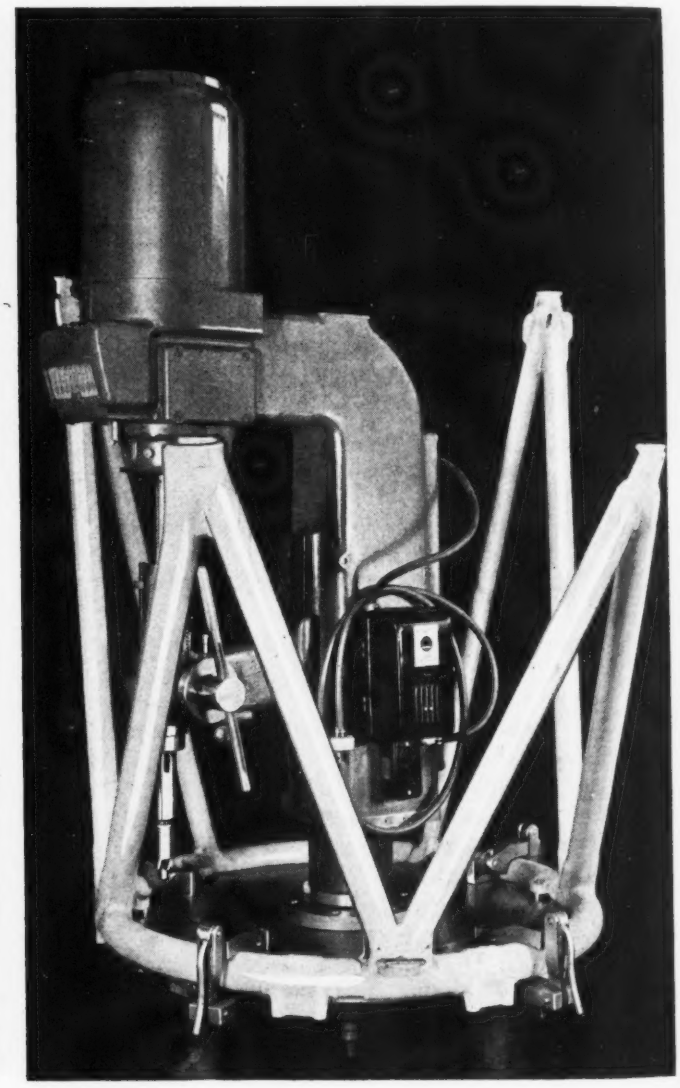


Fig. 2. Another Leland-Gifford Drill Head, Arranged Similarly to that Shown in Fig. 1, Back Spot-facing the Large Lug on the Engine Mount

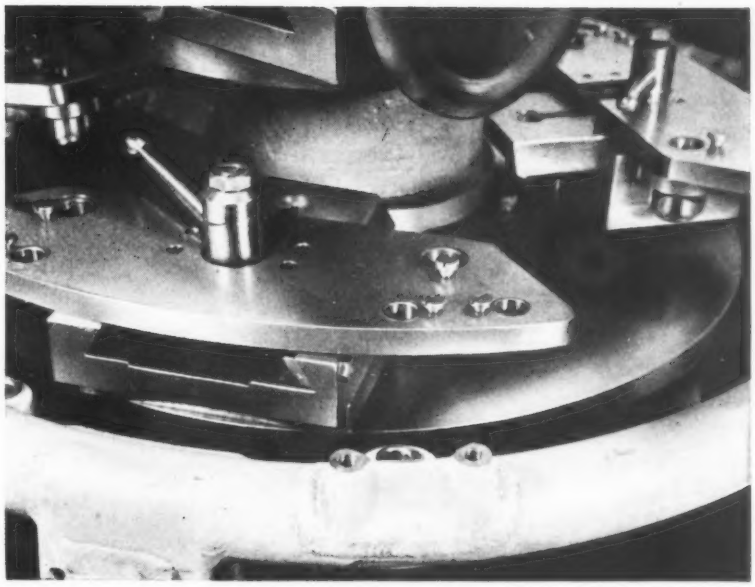


Fig. 3. Close-up View of Equipment Illustrated in Fig. 1, Showing Sliding Bushing Blocks, which can be Pushed back so that the Engine Mount can be Dropped over Drill Head

three holes each for two of the mounting pedestals. As shown in Fig. 3, these sliding blocks can be pushed back toward the center of the machine to permit the engine mount to be dropped over the drill head.

After the mount is located and fastened by four cone bolts on the machine base, the sliding blocks are pulled forward and locked in their proper location over the welded-on forged mounting lugs. On completion of the drilling, the bushing plate is pushed back, and the lugs are spot-faced, using a counterbore located from the drilled hole.

This counterboring is done to a threaded stop and checked with a dial indicator attached to the drill head. After spot-facing, the bushing plate is slid forward again, the two small holes are tapped, and the other hole reamed. The relationship between the four bulkhead attaching bolts and the tapped and reamed bosses is held within a few thousandths of an inch by this method, as is also the spot-facing of the bosses.

After tapping and reaming, the mount is put on the machine shown in Fig. 2, which is somewhat similar to the one just described except that it has no jig bushing plate, the spindle simply rotating at a fixed radius. This machine back spot-faces the under side of the large lug.

* * *

Australian Industry Pioneered in Tank Production

The Ministry of Munitions of Australia has reasons to believe that Australian industry was the first to produce cast hulls for tanks. In addition, construction of Australian tanks followed certain original lines that proved highly successful.

When France crumbled in 1940, the Commonwealth of Australia found that if it wanted tanks it would have to build them in its own factories. It faced considerable difficulties, because it had no automobile industry and no reservoir of highly skilled labor. At that time, British and American tanks were made from steel plate. Australia had no facilities for turning out heavy armor plate. It was, therefore, decided to make cast hulls. A foundry was built to produce both hulls and turrets on a mass production basis.

Then came the question of power. It was impracticable to use Diesel engines as in German tanks, or radial airplane engines as in American tanks. Instead, the Australians proceeded to use multiple automobile engines. Three Cadillac V-8 engines, coupled together in a clover-leaf design, provided the necessary power and speed.

* * *

American Society of Tool Engineers Elects New Officers

At the annual meeting of the American Society of Tool Engineers, held in Philadelphia on March 26, 27, and 28, the following officers were elected for the ensuing year: President, Douglas D. Burnside, superintendent of the Quick Meal Stove Co., Division of the American Stove Co.; first vice-president, C. V. Briner, manager Small Tool and Gage Division, Pipe Machinery Co.; second vice-president, A. M. Sargent, president Pioneer Engineering & Mfg. Co.; third vice-president, W. B. Peirce, works manager Flannery Bolt Co.; secretary, Earl V. Johnson, carbide tool engineer Firth-Sterling Steel Co.; treasurer, Floyd W. Eaton, personnel manager Crawford Door Co.; and assistant secretary-treasurer for Canada, L. G. Singer, district manager Williams & Wilson, Ltd. Adrian L. Potter is executive-secretary of the Society.

What the Product Designer

A General Understanding of Hot-Heading Methods is Essential in Designing a Product to Insure Economical Manufacture

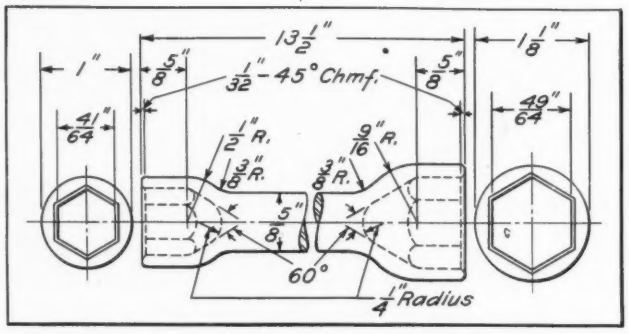


Fig. 1. Typical Hot-headed Double-end Socket Wrench

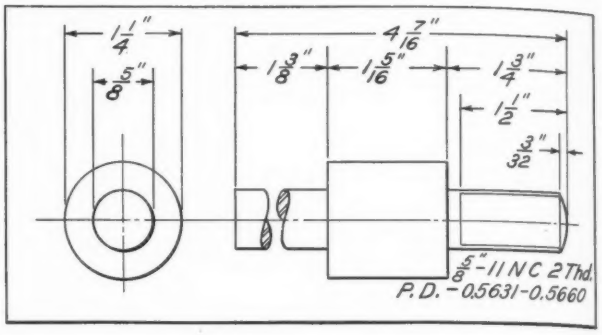


Fig. 2. Special Round-collar Bolt Made by Upsetting

NEARLY all headed products required in moderate to large quantities are produced on hot- or cold-heading machines or on screw machines. Except for certain classes of products, such as small rivets which are not considered here, the screw machine generally provides the most economical means of manufacturing small headed parts that are less than 1/4 inch in diameter. This is true because the total amount of scrap material removed from the bar stock is small, and rapid production can be easily obtained.

As the diameter of the product is increased, however, the production of headed parts or their equivalent on the screw machine becomes slower and more wasteful, while heading by upsetting becomes faster and more economical with regard to scrap or wasted material. Thus, bolts, screws, rivets and a great variety of other parts 1/4 inch in diameter or larger are nearly always produced in cold- or hot-headers, unless some special requirements are involved that cannot be met economically by this process.

The choice between hot- and cold-heading depends largely upon the size of the part, kind and suitability of the materials available, quantity or number of parts required, cost of tool equipment, and shape of head.

Sizes Adapted for Hot-Heading

In general, if the shank or stock diameter exceeds 1 inch and the length is over 6 inches, hot-heading is employed, though there are some exceptions. Below these dimensions, cold-heading is usually employed, unless the material specified is unsuitable for cold-heading or the quantities are small and the shape of the part to be produced is one that can be made in a standard hot-heading die which happens to be on hand.

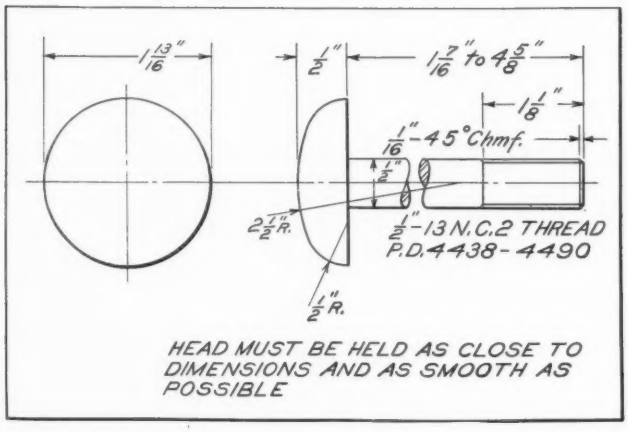


Fig. 3. Machine Bolt with Special Upset Head

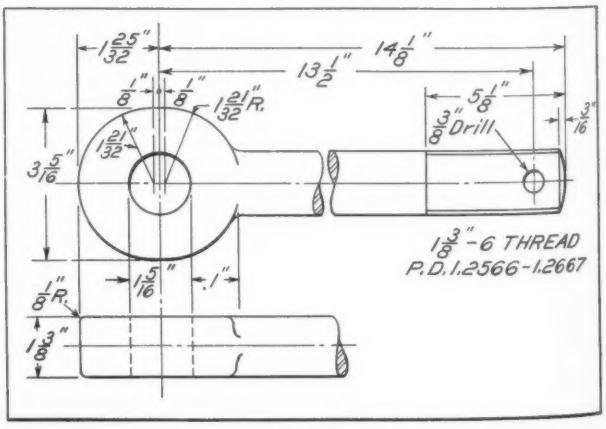


Fig. 4. Solid Eyebolt Produced by Upsetting

Should Know about Hot-Heading*

By A. E. R. PETERKA
Technical Assistant to the President
Lamson & Sessions Co., Cleveland, Ohio

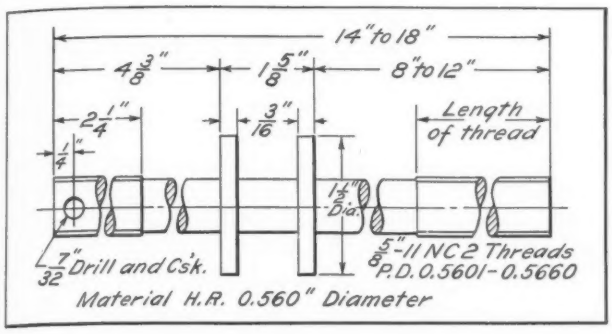


Fig. 5. Spool-shaped Part Produced in "Spring Dies"

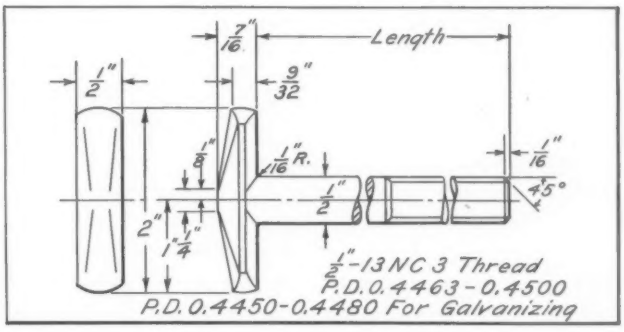


Fig. 6. T-shaped Bolt Produced by Two or More Blows

For cold-heading, the material must be sufficiently ductile to be headed at room temperature. Cold-rolled wire is employed, but several carbon steels are suitable, such as S A E 1010 to 1050, inclusive, as well as many alloy steels, such as S A E 2330, 4140, and 3135. Several non-ferrous materials, including certain grades of brass and some aluminum alloys, can also be cold-headed. Hot-heading can be done with any alloy suitable for hot-forging, but the steels most used include S A E 1010 to 1045, inclusive, 1110, 1120, 2330, 3135, and 4140.

As a rule, cold-heading is done only when the parts are required in large quantities, with the minimum number around 5000 pieces, as the die cost is likely to be prohibitive unless a standard die can be used. In hot-heading, however, where any length of piece above a given minimum can be run in a stock die for upsetting the head, shorter runs, say of 100 pieces up, are often feasible. However, in cases where a part having a special head that necessitates a special die is required, the quantity must be sufficient to justify the die cost.

Relative Cost of Hot- and Cold-Heading Dies a Governing Factor

Unless a stock die can be used, the quantity must be sufficient to warrant the die investment; but since the length of shank is fixed in cold-heading and can be varied at will in most hot-heading work, it follows that there is less chance of needing a special die in hot- than in cold-heading. A great many hot-heading dies, how-

*This article, together with the series "Design of Stampings to Facilitate Production" and "What the Product Designer Should Know about Plastics," previously published in MACHINERY, will appear in a forthcoming "Handbook on Designing for Quantity Production," prepared and edited by Herbert Chase.

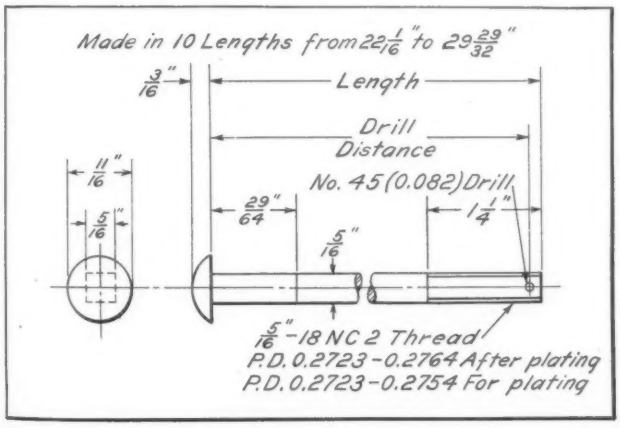


Fig. 7. Oval-head Bolt with Upset Square Section

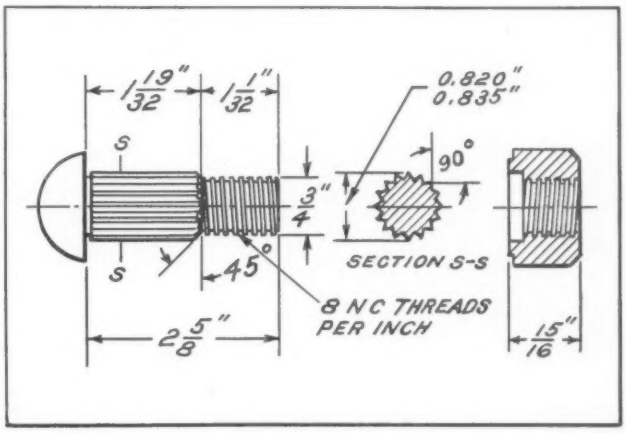


Fig. 8. Dardelet "Rivet-bolt" Made by Hot-heading

ever, have to be built especially for the job, particularly in cases where an odd size or shape of head is specified.

Advantages and Limitations of Cold- and Hot-Heading

Cold- and hot-headed products often have heads of identical shape and dimensions; but although all heads produced by the cold process can be duplicated in the hot process, the reverse is not true. A larger volume of metal can be upset hot than cold and many hollow heads that cannot be formed by cold-heading can be formed by hot-heading.

As a rule, closer dimensional limits can be held in cold- than in hot-heading and a somewhat smoother finish, especially on heads, is sometimes attained. Finish depends, however, in many cases on supplementary operations following heading, whether it is done hot or cold.

One of the best guides in determining the accuracy limits attainable is found in "Bolt, Nut, and Rivet Standards," published by the American Institute of Bolt, Nut, and Rivet Manufacturers, Cleveland, Ohio, although this does not indicate whether the products listed are produced by the hot- or cold-heading methods. The accompanying illlustrations indicate, however, what limits are held on certain typical hot-headed products.

Threads on all headed products are either cut or rolled (the latter method being preferred as being stronger, smoother, and faster to produce). Also, the threads are held within the limits for the thread classifications (which are usually No. 2 or 3) for American standard threads. Although aircraft bolts, which have to be held within unusually close limits, are produced chiefly by cold-heading when the lengths are 6 inches or under, many that are longer than 6 inches are successfully hot-headed. In both cases, however, supplementary finishing operations are performed after heading and heat-treating.

Under present conditions, when steel of certain grades is difficult to secure and some grades are restricted to applications involving high priority ratings, designers should, where possible, allow for the use of alternative steels when a particular specification is indicated. Also, they should use carbon steels in preference to alloy steels, unless the latter are essential. If the specification calls for suitable heat-treatment or for physical properties that necessitate heat-treatment, much material can often be saved by using a heat-treated steel, as against using parts that are not heat-treated and that, therefore, have to be of much larger diameter than they would need to be if suitably heat-treated. For example, a 1/2-inch-20 or even a 7/16-inch-20 bolt of S A E 1035 steel, properly heat-treated, can be used in place of a 3/4-inch-10 bolt of hot-rolled 0.14 to 0.22 per cent carbon steel, not heat-treated. The smaller bolt will have substantially the same factor of safety, and, of course, will effect a marked saving in the amount of steel used.

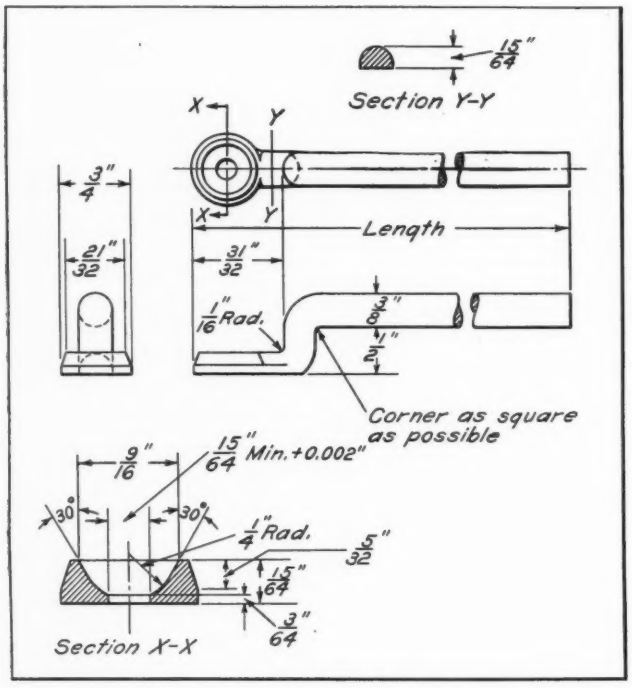


Fig. 9. Eyebolt with Special Offset Recessed Head Produced by Hot-heading

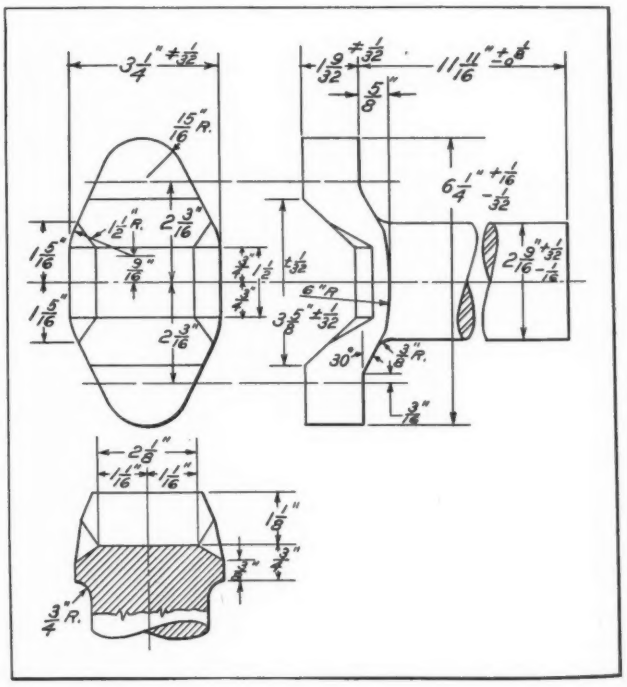


Fig. 10. Bolt with a Y-shaped Head—Another Example of a Part Produced by Hot-heading

Heads that are upset cold are usually circular in sections at right angles to the axis, but are often trimmed to square, hexagonal, or other shapes. Marks of the shearing tools frequently show on the flat faces formed. In hot-heading, the metal is soft enough to be upset into hexagonal or square shapes, but there is a flash left at the bottom of the hexagon where the hammer clears the die, and this flash has to be sheared off; hence, shear marks show only for the thickness of the flash.

As hot-forging requires that the metal be heated to forging temperature, the part forged shows the effect of heating, unless subsequently treated; but by using a reducing flame in the furnace, little scale is formed on the finished piece. Since hot-forging requires a furnace and a man to operate it, in addition to the labor of a hammerman who handles each piece separately, labor and fuel charges are higher than for cold-heading, and the rate of production is lower. Often this offsets the higher die charges for cold-heading, but, nevertheless, hot-heading is used because it can be applied where cold-heading is not feasible.

Hot-heading is not confined, of course, to bolts or to other conventional-shaped parts on which a head is formed at the extreme end. It is possible to upset a flange that is not at the end of the piece, and also to form heads that are not symmetrical about the axis of the shank. Heads of T-shape and conical or spherical shape are readily upset, and it is possible to forge a crank-shaped or offset part. Hollow heads, especially

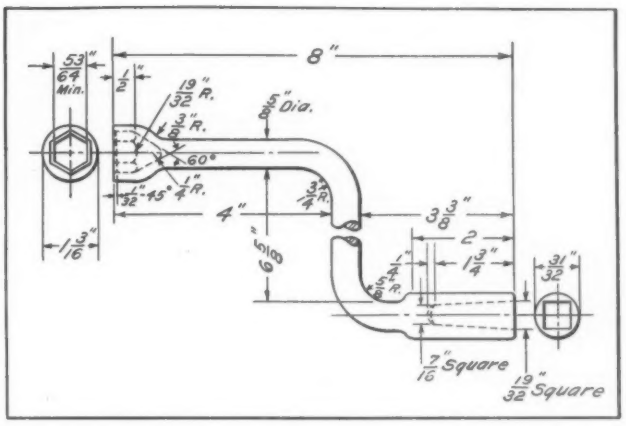


Fig. 13. Socket Wrench with Upset Head and Handle

for socket wrenches, are usually hot-headed, the hammer having a projection that forms and shapes the hole while the die forms the exterior shape.

Heads are often upset in a single blow when they are of moderate size and the amount of metal that flows into them is not too great, but several blows are often struck by the upsetter as the piece is shifted into a corresponding number of die cavities. Heads up to two and one-half times the stock or shank diameter can be formed, and the volume of the upset portion is sometimes such that as much as 5 or 6 inches of the bar stock is upset into the head, though this may take as many as seven blows. Of course, such cases require a die having seven recesses and a hammer suitably shaped in successive

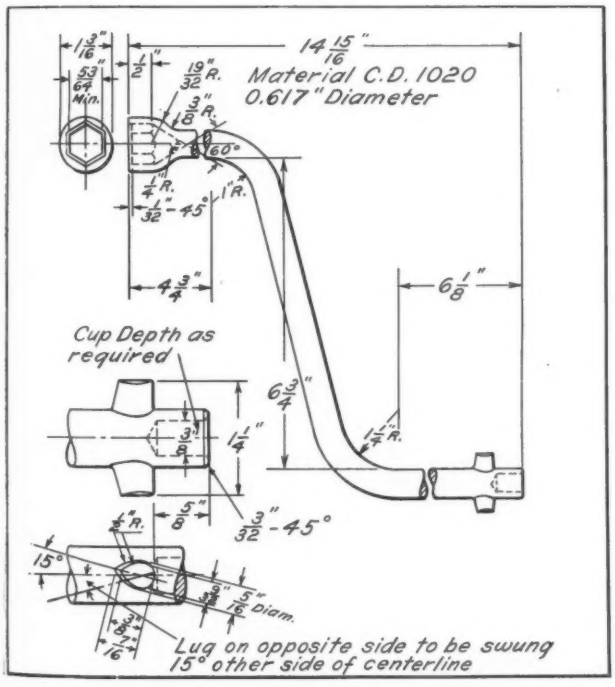


Fig. 11. Socket Wrench with Cross-shaped End Produced by Hot-heading

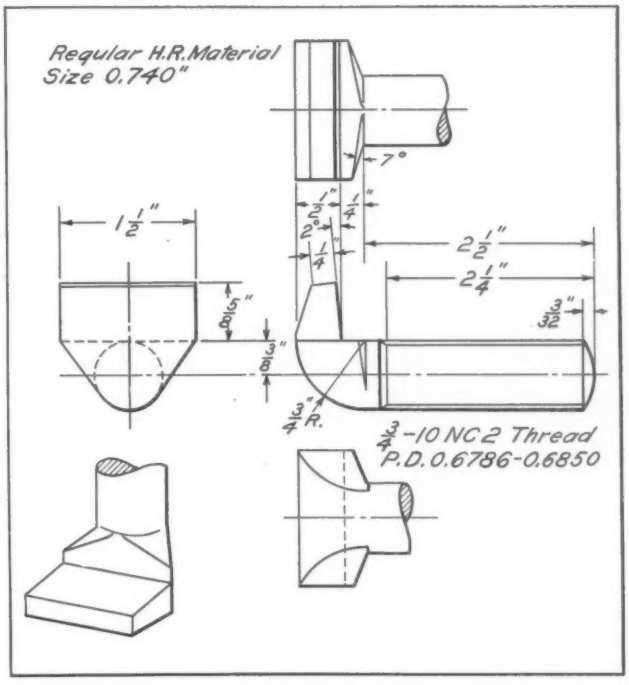


Fig. 12. Bolt with Offset Head of Special Design Made by Hot-heading

Fig. 14. A Group of Miscellaneous Parts Produced by Hot-heading Operations

positions to produce the upset without bending the end of the rod, which has been heated to forging temperature.

The accompanying illustrations which, along with the data here given, were furnished by the Lamson & Sessions Co., give a good idea of some of the special parts produced by hot-heading, and show what dimensional limits are held. Such special parts are essential for certain applications, of course, but much die cost can be saved, naturally, when the upset can be so designed that a standard head, for which dies are on hand, can be employed. Detail dimensions of such standard heads are given in the publication "Bolt, Nut, and Rivet Standards," previously referred to.

Although it is entirely feasible to produce nut blanks by hot-heading, and to do it with almost no scrap, production is much slower than that attained in the combined hot-punching and shearing of blanks from flat strip stock of the required thickness. For this reason, nut blanks are usually produced by the latter method in machines designed especially for the purpose, although this method results in considerable scrap.

Fig. 1 shows a typical hot-headed double-end socket wrench, and indicates how the ends of the bar, which are approximately 5/8 inch in diameter, appear after the final blow. The first blow merely upsets the end. In the second blow, the end is pierced with a punch of circular section having a conical point. In the final blow, the hole is given a hexagonal shape and, of course, the specified external shape and wall thickness. The depth of holes pierced in this manner is commonly limited to about one and one-half times their diameter. A socket can be formed or other upsetting done on both ends of a bar, as indicated, provided the length of shank between is at least equal to the thickness of the die, or, say, a minimum of 4 inches.

In Fig. 2 is shown a special part in which a large upset portion is formed between two cylindrical ends, one of which is of stock size. Because of the volume of metal in the upset, five blows are required to produce this piece from 1010 hot-rolled steel.

To produce the rivet-shaped part illustrated in Fig. 3 from 1/2-inch stock requires seven blows, largely because of the volume of metal in the head, as compared with the diameter of the shank. It requires a 5 1/2-inch length of bar to produce the head, and this length has to be worked down in several blows, as otherwise the piece would be bent rather than upset as desired. As in all headed parts, there is a large saving in metal, of course, compared with machining the part from a bar having the diameter of the head.

Solid eyebolts, such as shown in Fig. 4, are readily produced by upsetting. It is quite feasible, for example, to upset a head 3 5/16 inches in diameter and 1 3/8 inches thick from the hot-rolled stock which, in the case shown, has a diameter equal to the head thickness. A head either thicker or thinner than the stock can be upset, however.

Fig. 9 shows a special eyebolt with an offset recessed head. Producers of eyebolts furnish them blank or with the hole for the eye drilled, as specified.

In Fig. 10 is shown a Y-shaped headed part produced in three blows. The cost of making a part of this shape by any method other than upsetting would, obviously, be prohibitive. Heads of spherical shape are readily produced by upsetting, the number of blows depending chiefly upon the volume of the head in reference to the shank, which is of stock size.

Round bar stock is nearly always used in hot-heading, but it does not follow that the shank of the piece produced must have a circular section throughout its length. The part shown in Fig. 7, for example, has a square section for a part of the length below the head.

Dardelet "rivet-bolts," shown in Fig. 8, have a length under the head that is serrated or fluted. They are produced by hot-heading, but usually in a special form of bar-header which operates much like a cold-header, except that the rod

stock is heated to forging temperature before the heading is done and the stock is sheared to length in the machine. Similar results can be produced in upsetters in which the piece is handled with tongs, though the operation is slower than in a rod-header, which operates automatically. "Rivet-bolts" of this type are regularly made in diameters ranging from 3/8 inch to 1 1/2 inches.

In Fig. 5 is shown a spool-shaped part produced in an upsetter using what are termed "spring dies" to form the section between the two flanges. This piece is of somewhat unusual shape, and, of course, requires special tooling, but is an example of one type of part that is feasible in hot-heading when the quantities required justify the tooling cost.

Parts having a T-shape, as shown in Fig. 6, can be produced in two or more blows of the header. The first blow gives the piece a Y-shaped form besides upsetting it, and in the final blow, the cross-bar is formed to obtain the finished shape.

It is rather unusual, but entirely feasible, to produce parts having a cross shape by hot-heading. The hot-headed part shown in Fig. 11, for example, has a cross-shaped part at one end and a recessed head at the opposite end. The integral pins that form the cross project at each side, and are really extruded into holes in the die by the blow of the punch which forms the recess in the head at the cross end. A hot-headed part produced in this way is much stronger and may cost less than one made without the integrally forged pins, which has been drilled and has a cross-pin inserted.

Parts with heads that are offset to one side only, as in the case of the clamping bolt shown in Fig. 12, can be produced by hot-heading. A forging is essential for the quantity production of such parts, and they are rapidly made in an upsetting machine.

A part that has an upset eye head with a recess at one side, as illustrated in Fig. 9, may have the shank bent to a crank shape, as shown, after the head has been formed, all the work being done in the upsetter. Socket wrenches having crank-shaped handles (see Fig. 13) are similarly made, as are also socket-ended cranks for the hand-starting of internal combustion engines.

A group of various parts produced by hot-heading is shown in Fig. 14, which gives some indication as to the different shapes and the range of sizes that can be made by this process.

Fig. 15. Examples of Special and Standard Bolts Made in Hot-heading Machines

Many are produced in very large quantities, and some from alloy steels or heat-treated carbon steel to meet exacting specifications. Long aircraft bolts are among the hot-headed products that require polishing operations and that are subjected to exacting tests, including magnetic tests for location of any superficial or sub-surface flaws.

Numerous special and standard hot-headed products, some of which are shown in partly finished and others in finished form, are illustrated in Fig. 15. These, of course, are only a few selected from hundreds of special parts manufactured by hot-heading, but they give some idea as to the variety of parts that can be manufactured by the processes here described.

* * *

Magnesium Association Recently Formed

To foster the use and development of magnesium alloys and to increase the knowledge of fabrication methods among producers and fabricators, the Magnesium Association, 2537 W. Taylor St., Chicago 12, Ill., has been formed. Magnesium promises to find ever increasing applications in peacetime industry, and for that reason, the formation of a permanent association was found advisable. There are today over one hundred companies engaged in the fabrication of magnesium and its alloys. A number of other firms are investigating the properties of the metal with a view to engaging in its fabrication or incorporating its use in post-war products.

Editorial Comment

Throughout industry, the disposal of the surplus equipment owned by the Government at the end of the war is recognized as one of the major post-war problems. The machine tool industry, in particular, is vitally concerned in the solution of this problem because of the tremendous output of the industry during the war years and the correspondingly large surplus that will be available at the end of the war.

Disposal of Surplus Machines is a Major Post-War Problem

Since the machine tool industry responded in such a remarkable manner to the Government requirements, expanding its output to more than seven times the highest peacetime production, it would be most unfortunate if the industry should be penalized for this effort by having to compete with the Government surplus of machine tools at the end of the war. Such competition could be so severe that it would be practically impossible for some of the machine tool companies to remain in business. Since this industry is vital to all the machine-building and metal-working industries, it would be very serious if it should be crippled through ill considered methods for disposing of the surplus equipment.

Much thought has been given to this subject, both by the industry itself and by various Governmental agencies. Several bills have been introduced in Congress for the purpose of regulating the disposal of the surplus. On the whole, these bills are somewhat similar in the methods proposed. They provide that Arsenals and Navy Yards be given first opportunity to acquire from the surplus all the equipment that they need, not only for immediate use, but as stand-by equipment for emergency conditions. Trade schools and other schools and colleges with mechanical training courses would be given the next chance to acquire modern equipment for their needs out of the surplus. Next, foreign countries would be permitted to rehabilitate their machinery industries, under lend-lease, by drawing upon this vast surplus of equipment.

Bills in Congress Suggest Channels of Disposal

After all these needs have been met, however, there is still likely to be a sizable surplus, which, if immediately thrown upon the market, would have a demoralizing effect upon the entire machine tool industry. Since this is so fundamental an industry, upon which the entire nation depends for its continued prosperity, no one would want this to be done, nor has it been proposed in any quarter that it should be done. No generally accepted agreement has been reached, however, as to the methods by which this surplus should be gradually disposed of.

Two methods have been suggested that are considered to have merit. According to one, the machine tool industry would be "rationed" by the Government in such a way as to permit each manufacturer to sell a certain number of new machines of a given type to each machine of his own make that he sold from the Government's surplus. This would make it possible for the industry to maintain a certain amount of activity while, at the same time, the surplus would be gradually disposed of.

Future of Machine Tool Industry Must be Safeguarded

Another plan, somewhat similar in character, contemplates that the Government determine the volume of minimum business that would be required by each machine tool company in order to enable it to continue to do business. Surplus machines in the hands of the Government would be sold only after each manufacturer had disposed of, annually or semi-annually, as the case might be, the minimum quota necessary for him to stay in business.

Doubtless, through the cooperation of the National Machine Tool Builders' Association and the Government agencies concerned with the disposal of surplus equipment, some plan can be worked out by which an industry that has acquitted itself in such a commendable manner will be given an opportunity to conduct business on a basis that will insure the welfare and security of the entire nation. A healthy machine tool industry, capable in peacetime as well as in any emergency of equipping the plants of the nation with the required means of production, is essential to national security and prosperous conditions in all industrial fields.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Mechanism with Two Reciprocating Slides Driven from One Crankpin

By L. KASPER

On a wire forming machine, a reciprocating motion was imparted to a sliding member by a crank disk to which it was connected by a pitman rod. Owing to a change in the design of the product, it became necessary to add another sliding member, which would carry the original sliding member. The added sliding member had to be given a reciprocating motion relative to the original sliding member, both motions being transmitted from the same crankpin. This was accomplished in a comparatively simple manner, as shown in the accompanying illustrations.

Referring to Fig. 1, the disk *D*, rotating in the direction indicated by the arrow, imparts a reciprocating motion to the slide *C* through the crankpin *I* and the pitman rod *E*. This constituted the original movement before any changes were made. The slide *B*, which was added, has a dovetailed base which is a sliding fit in a dovetail groove in member *A* of the machine, and carries the part *C* which is similarly mounted in slide *B*.

The lever *G*, pivoted on crankpin *I*, is connected at one end to the link *H* by the stud *K*, and at the other end to the pitman *F* by the stud *L*. Pitman *F* is connected to slide *B*, and pitman *E* to slide *C*, each transmitting the motion received from lever *G*, which is actuated by crankpin *I*. Link *H* is pivoted on stud *J*, which is stationary on member *A*.

In Fig. 1, crankpin *I* is shown at the top dead center position. At this point of the cycle, slides *B* and *C* occupy the relative positions indicated by the dimension *X*, measured through the centers of the studs. In Fig. 2, crankpin *I* is shown at the bottom dead center. As lever *G* is operating in the third order, the greatest movement takes place at the work end, or at stud *L*. By

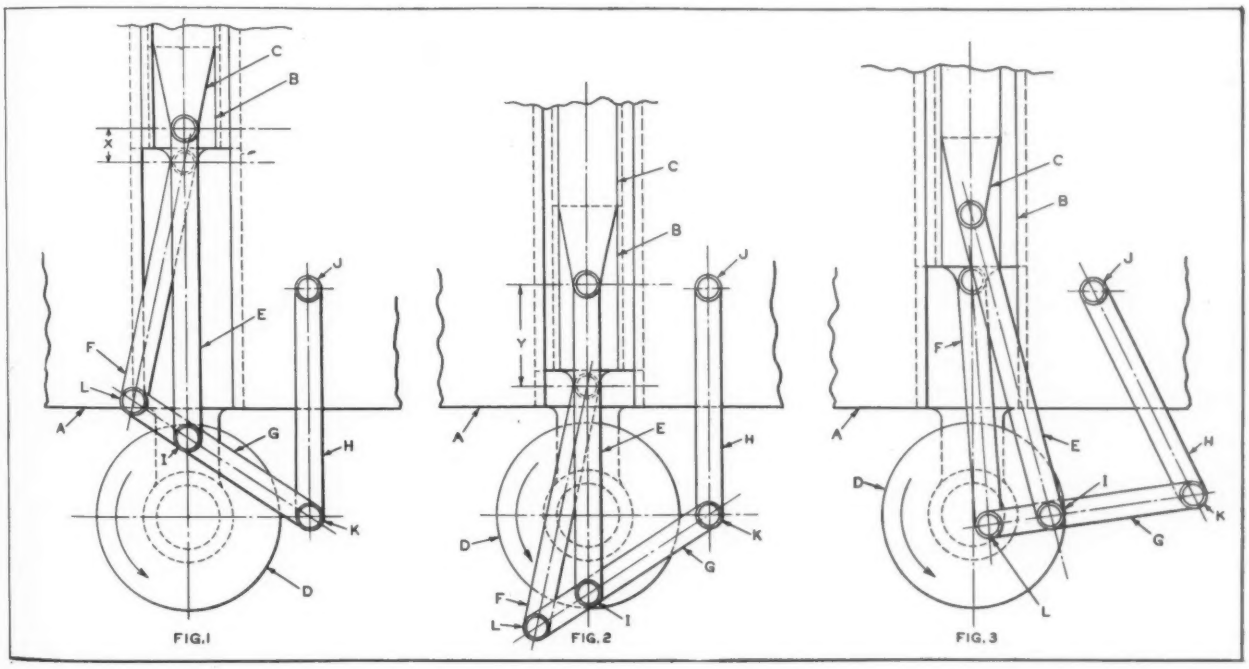


Fig. 1. Mechanism with Two Slides B and C Driven by One Crankpin I, Shown at Top Dead Center Position. Fig. 2. Mechanism with Crankpin I Shown at Bottom Dead Center Position. Fig. 3. Mechanism Shown with Slides in Position Occupied after Crankpin I has Made Three-fourths Revolution from Position Shown in Fig. 1

virtue of this action, slide *B* is given a greater downward movement than slide *C*. The relative positions of the slides *B* and *C* are shown by the dimension *Y*, which is greater than dimension *X*, Fig. 1, indicating the difference in the movements of the two slides *B* and *C*.

In Fig. 3, crankpin *I* is shown in the position it occupies after completing three-quarters of the cycle. This illustrates the action of link *H*, the purpose of which is to provide a floating fulcrum for lever *G* without resorting to a slotted member or other form of track for stud *K*. Fig. 4 is an end view of the assembly, showing the relative positions of the levers.

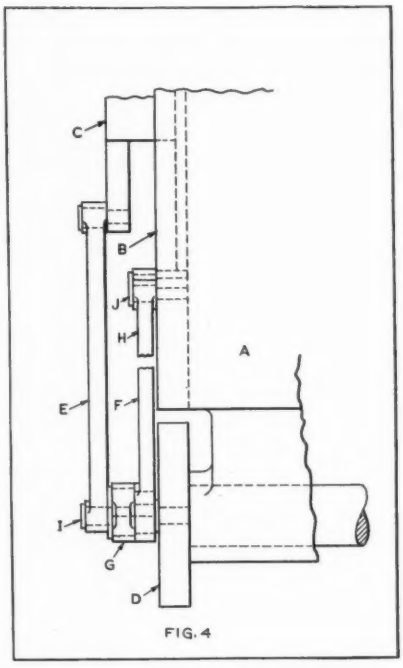


Fig. 4. End View of Mechanism Shown in Fig. 3

* * *

Points on the Application of Needle Bearings

In a statement published some time ago by G. R. Trumbull, of the Torrington Co., Torrington, Conn., a number of points relating to the application of needle bearings are brought out which are of interest to engineers in general.

Briefly, a needle bearing consists of a large number of rolls of comparatively small diameter retained in an accurately drawn, hardened outer shell. This outer shell is the only raceway for the rolls. The shaft supported by the bearing forms the inner race, since the rolls rest directly on the shaft. The housing and shaft tolerances are within the usual requirements for precision anti-friction bearings. As the shaft is the inner race for the bearing, it must be hard in order that the full bearing capacity can be obtained.

One of the advantages of a needle bearing is that it is lighter and has a smaller outside diameter, of greater radial capacity, than corresponding sizes of anti-friction bearings. It is suitable for applications where the loads are either light or heavy and where a low coefficient of friction is desired. The full complement of small-diameter rolls contained in the outer shell offers a maximum contact area.

The close fitting lips of the needle bearing shell provide storage capacity for lubricant and also act as an effective seal, retaining the lubricant and excluding foreign matter. The lubricant to be used is determined by the application, and bearings may be packed at the time of assembly with suitable greases.

The press fit of the needle bearing is sufficient to hold it firmly in place, no staking or other method being needed to insure that the bearing will be retained in its housing. Care should be taken to avoid pressing the end of the bearing against a shoulder, because the thin shell of the bearing can be pressed in sufficiently to lock the rolls and thereby make the bearing inoperative.

If two bearings of the same size are to be used at opposite ends of a housing, it is easier to maintain correct size and alignment by boring right through the housing rather than by counterboring at each end.

To obtain the full bearing capacity, the shaft should have a surface hardness of Rockwell C 52 for regular type bearings, and Rockwell C 58 for what are known as "extra capacity" bearings.

A needle bearing is assembled into its housing by pressing it in place with an arbor press equipped with a suitable pressing tool. Whenever possible, a pilot should be provided to insure that the bearing enters its housing in proper alignment. The pressure should be applied to the bearing on the stamped end, as this end is heavier and can better withstand installation pressures. Under no circumstances should the bearing be installed by tapping or pounding on the shell.

* * *

New Method for Marking Metal

A new electrolytic method for marking metal has been developed by the Acme Marking Equipment Co., 2222 W. Fort St., Detroit 16, Mich. The method, known as "Met-L-Etch," consists of a unit, 2 by 6 by 9 inches, with a 110-volt alternating-current transformer. By means of this method, names, numbers, trademarks, and inspection symbols are quickly and permanently etched on smooth metal surfaces without the use of acid. The operating procedure is simple: A drop of the conducting solution, good for 500 impressions, is applied to a silver pad on which rests a celluloid stencil engraved with the mark to be etched. The part to be marked is then placed on the stencil, and the current is turned on. One second is sufficient to produce a permanent mark.

How to Secure Fine Surfaces by Grinding

By the Late H. J. WILLS
and H. J. INGRAM, Engineer
The Carborundum Co., Niagara Falls, N. Y.

Twelfth of a Series of Articles Describing the Factors that Govern Fine Surface Quality and the Means by which This Quality Can be Obtained — The Present Article Deals with Lapping Operations in the Tool-Room

STELLITE and cemented-carbide tools that are to be used for finish cuts of good quality, and those that are to be used on materials having a strong abrasive action on tools, should always be lapped. The smooth edge obtained by lapping makes for tool economy, rapid production, and high surface quality of the work.

Although an edge ground in the usual way may seem smooth to the touch, when looked at under the microscope it is seen to be composed of high hills and deep valleys, while the edge of a lapped tool is flat. In cutting, the projecting hills carry far more than their share of the load, and so break off, making resharpening too frequent for economical tool life. In the meantime, the tool tears off the material in a manner that makes it difficult or impossible to obtain a fine finish. Finally, it is obvious that a dull tool holds down production.

Either Stellite or cemented-carbide tools may be lapped with a compound consisting of silicon-carbide abrasive in a soluble oil vehicle. When this compound is used, the lap is made of either close- or open-grained cast iron, and when diamond dust is used as the abrasive, the lap should be made of close-grained cast iron.

The laps are mounted on either horizontal or vertical spindles. Most lapping machines revolve the disk at too high a speed. It pays to reduce the speed to from 900 to 1200 surface feet per minute, as this will prevent the expensive compound from being thrown off by centrifugal force. Slower speeds increase the rate of stock removal—higher speeds give a higher polish.

In lapping with a silicon-carbide compound, the best practice is to apply a small amount of the compound to the lap and hold the tool firmly to its face in such a way that the direction of rotation is toward the cutting edge and at an angle of 90 degrees to it. When all of the edges have been brought to a satisfactory condition, the surfaces will have a dull matte finish, which, in many cases, indicates better surface qualities and a sharper edge than a highly polished finish. Polish is not an indication of a good edge.

If, however, a semi-polished surface is desired, a second lapping may be given on the dry lap. For this, the tool should be so held that it will lap at a 5-degree angle to the cutting edge, front to back. If the tool is of such a shape that it can be securely held without tilting it, this operation should be performed while giving the tool a swinging motion across the direction of rotation from 0 to 90 degrees to the edge and from back to front. If a still higher finish is desired, the final lapping may be done with a compound of FF grit silicon-carbide grain in an oil vehicle.

While more expensive than the silicon-carbide compounds, diamond compounds are highly effective for lapping cemented-carbide tools on a revolving cast-iron disk. For this operation, the table is set to hold the tool at an angle 1/2 degree less than that used for grinding, in order to reduce the area of the tool in contact with the lap. This develops the cutting edge faster than would be the case if the entire surface of the tool were in contact with the lap. Never lap the soft steel part of the tool, for the steel will wipe the abrasive off the lapping disk.

In lapping with diamond dust or compound, it pays to follow these suggestions:

1. Be sparing in the application of the dust, for the lap will be impregnated with it excessively, thus wasting expensive material.
2. Examine the work frequently with a magnifying glass of at least 10 power, in order to determine just when the desired edge is achieved. This will save time that might be wasted in unnecessary lapping.
3. Always have the lap revolve toward the cutting edge.
4. Continue lapping until all grinding marks have been removed.

Thread chasers are lapped with a rod made of cast iron for diameters of 1/2 inch or more, and of brass or copper for diameters of less than 1/2 inch. The proper thread is, of course, cut on the rod. The lap, in this case, is chucked in a speed lathe with a tailstock center. A rest for the chaser is provided which is parallel to the

lap and at such a height that when the chaser is lying flat it will be at the correct level and slope. Since some chasers require localized lapping, it is well to have the rest easily adjustable for height and slope.

While the lap is rotating at about 350 R.P.M., apply compound to it with a narrow brush at a point toward the top of the rest. Threads coarser than ten to the inch are lapped with a compound of F grit aluminum oxide in a soluble oil vehicle. Somewhat finer threads call for FFF grit aluminum oxide in soluble oil. The very finest threads are lapped with 1000-grit aluminum oxide in a grease vehicle.

The chaser is held in the fingers and pressed lightly into the lap, which will move the chaser across and finally out of contact with the lap. The chaser is then returned to the starting point and the process repeated until a smooth edge is achieved.

If a shop has properly maintained and installed cylindrical grinding machines, it is possible to *grind* plug gages to the required accuracy and surface finish. But most shops that make their own gages, and many that make gages for sale, have to give the gages a final lapping operation.

Plug gages may be lapped by hand or on a lapping machine. When lapping by hand, use an adjustable split cast-iron lap. The gage is rotated at about 600 R.P.M., while the lap is oscillated across the surface. If the ground surface is good, 0.0002 inch is sufficient stock to leave for lapping. The rough-lapping is done with 220-grit aluminum-oxide abrasive in a grease vehicle; for the finish-lapping, the same type of compound is used, except that the grit size is 400.

The special abrasive used in lapping gages is easily fractured; therefore it is necessary to be careful not to apply heavy pressure. This process will give the gage more or less of a matte surface, which is just as good as a polished one; but if the gages are to be sold, it may be desirable to give them an additional operation to provide luster. This can be done by using a cloth and aluminum-oxide paste while the gage revolves. With the same compound, a soft cloth will give a slight abrading effect, while a harsh cloth will give a greater effect.

If considerable numbers of gages of the same size are to be produced, it is well to do all the lapping on machines having one rotating and one stationary cast-iron lap. The work is held in a spider. If there is much material to be removed, use FFFF silicon-carbide abrasive in an oil vehicle. If only a little material is to be removed, use a compound consisting of 600-grit aluminum oxide in an oil vehicle.

If a high luster is desired, the gages may be finished on a dry cast-iron disk, which is rotated while the gage is held against it by hand in a fixture which has centers to permit the gage to rotate. The gage is held against the disk at an angle to the radius of the disk.

It is extremely difficult to lap a ring gage without bell-mouths. Some gage-makers make the gages longer than the finished size, and after lapping, cut off the bell-mouthed ends. The lapping is done with an expanding cast-iron or brass lap, which is held in the hole while the lap is rotated at about 250 R.P.M. If the hole is a small one, 400-grit aluminum oxide in a grease vehicle is used. Large holes are lapped with the same type of compound, using 220-grit abrasive.

Dies and molds are usually given their rough shape with a shaped abrasive stick. Final shaping and rough-finishing are done with the same stick to which a lapping compound has been applied, using the same cutting speed as in rough shaping. This gives a surface completely free of grain marks—which, of course, saves the time that would otherwise be expended for later operations.

Roughing is done with a flexible rubber abrasive stick or a mounted wheel of 60-grit aluminum oxide, either wet or dry. Rough-finishing is done with a driven whitewood or lead lap and 220-grit aluminum oxide in a grease vehicle, where this is possible. However, some work is so small that these tools cannot be used. For such dies, the same compound is applied by means of an orangewood stick.

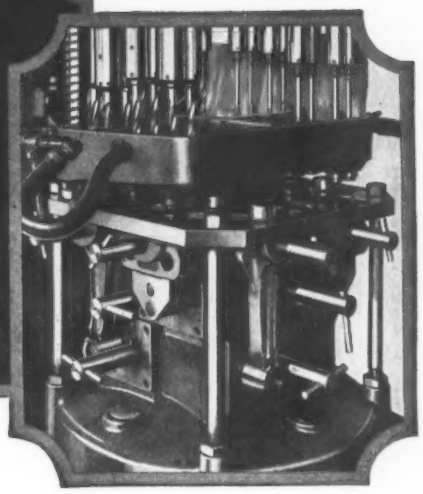
To remove the grain marks left by these operations, it is necessary to finish molds and dies with a chrome leather lap used with the same compound, except that the grain size is 400. A still finer finish can be secured by applying the same compound with a lap made of medium-hard white felt. An exceptionally high finish can be obtained by applying a 400-grit aluminum-oxide paste with a soft rag lap.

* * *

Milling Cutters with Fewer Teeth Give Better Results

According to Fred W. Lucht, engineer with the Carboloy Company, Inc., Detroit, Mich., one of the most important considerations in milling steel with cemented carbides is the selection of the correct number of teeth for the cutter. Since increased cutting speed means more cubic inches of metal removed per minute, and therefore greater power consumption, it frequently becomes necessary—due to power limitations—to reduce the load in some manner. In such a case, it usually proves to be better practice to decrease the number of cutter teeth rather than reduce either the feed or the cutting speed. Maintaining sufficient feed per tooth is important in steel cutting, particularly in roughing.

Design of Tools and Fixtures



Profile Milling Fixture Manipulated by Automobile Steering Wheel

By VICTOR S. VOIGT, Tool Engineer
Westinghouse Electric & Mfg. Co.
Mansfield, Ohio

An automobile steering wheel is employed as shown in Fig. 1 to manipulate a work-holding fixture for an intricate profile milling operation. The particular part for which this fixture is used is of die-cast aluminum. The extremely thin walls and irregular shape of the work introduced a difficult chucking and holding problem. Fig. 2 shows the fixture with the work removed.

In using this quick-acting clamping fixture, the piece is first clamped in place, after which the profiling cutter is lowered into the part. The operator then turns the steering wheel, which brings the surface to be profiled against the cutter. The fixture is so mounted as to move over an irregular path, which causes the cutter to follow the contours of the work.

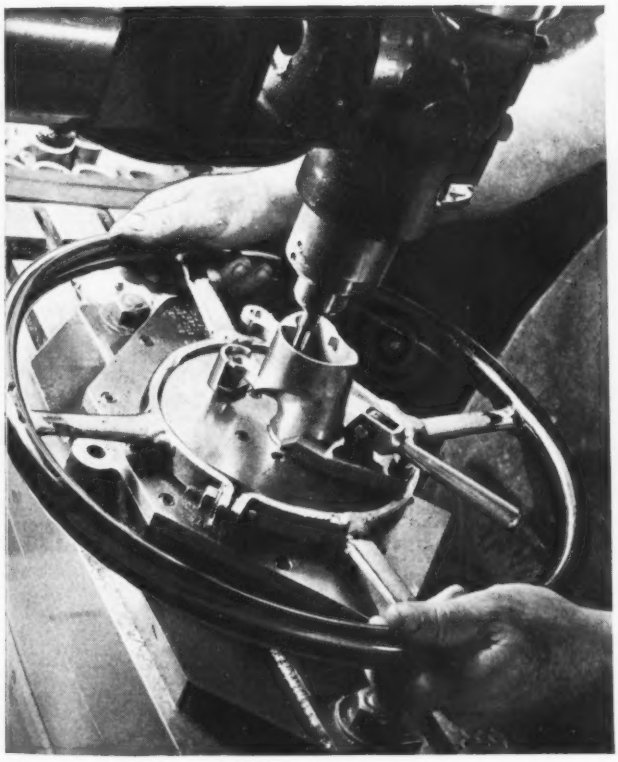


Fig. 1. Fixture with Steering Wheel Arranged to Feed Work to Profile Milling Cutter

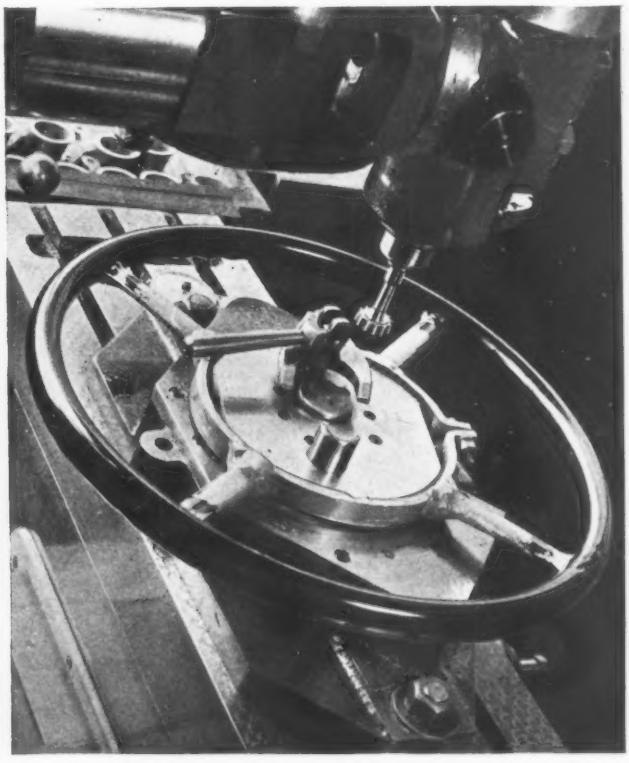
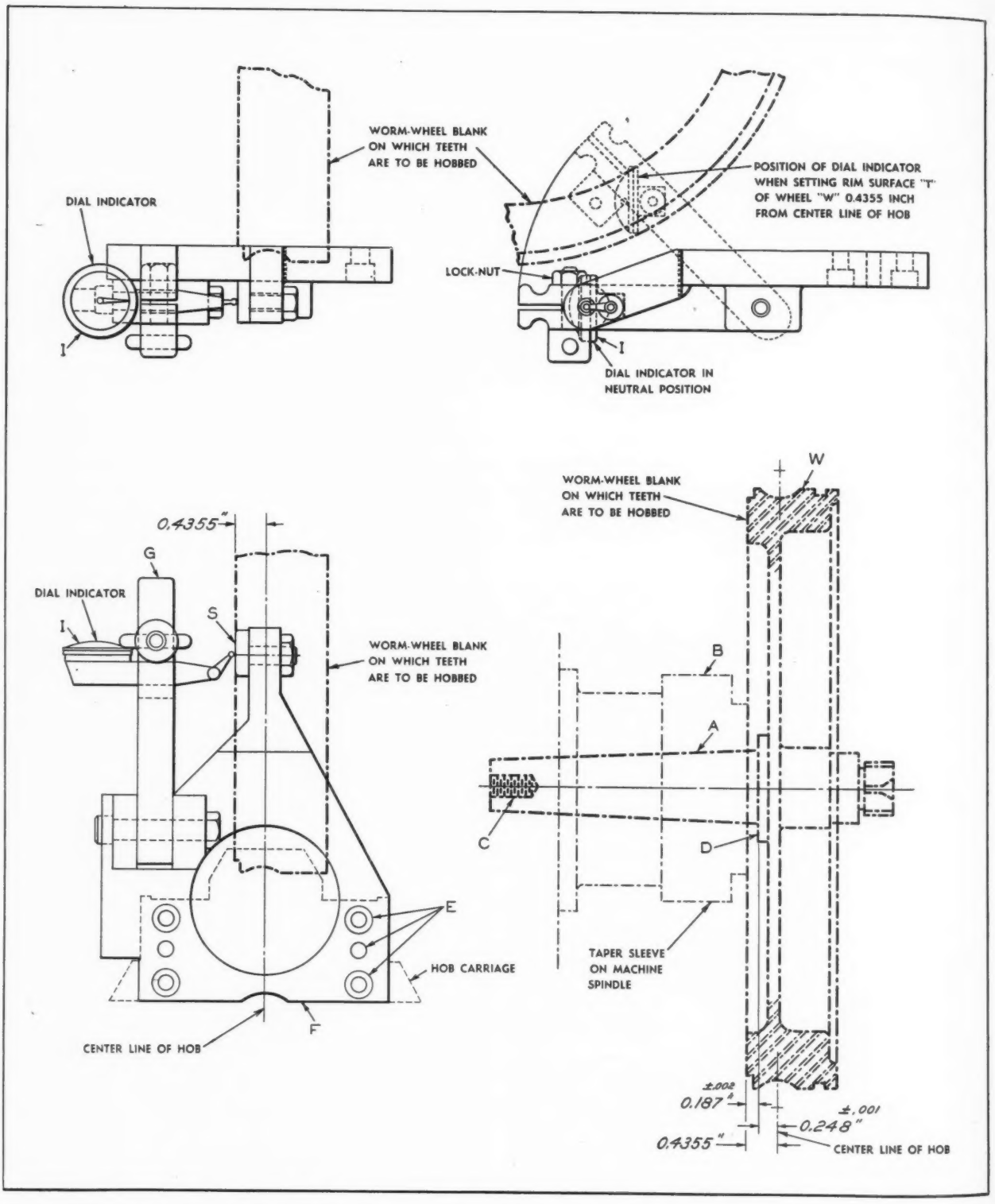


Fig. 2. Fixture with Work Removed, Showing Quick-acting Clamp for Milling Operation

Simple Attachment for Precision Worm-Wheel Hobbing

By EDWARD LAY, Ozone Park, N. Y.

Hobbing the teeth of a special worm-wheel to meet rather exacting specifications presented an interesting problem, which was solved by devising the simple inexpensive attachment shown in the accompanying illustration. The periphery of the worm-wheel *W* was required to be concentrically and accurately positioned with respect to its tapered hub *A*. The distance from the shoulder at the end of the hub to the center line of the worm-wheel teeth was required to be 0.248 plus or minus 0.001 inch, as indicated.



Diagrams Illustrating Method of Using Simple Attachment to Insure Accuracy in Hobbing Worm-wheel

The close tolerance on this dimension eliminated the possibility of holding the wheel blank between centers in the usual manner.

In order to insure accurate functioning of the worm-wheel, the teeth had to be cut by a method that would duplicate the exact working conditions under which the assembled worm-wheel unit was to operate. This was done with the aid of the equipment shown. A spindle with a taper sleeve *B* machined to fit the hobbing machine was provided to fit the hub *A*.

The small end of the tapered wheel hub had a fine thread at *C*, which was utilized to hold the wheel securely to the spindle nose by means of a draw-in rod. Since this fine thread could be easily stripped, the writer designed a nut that limited the pressure or pull exerted on the threads, and thus eliminated any danger of stripping. The difficulty in setting up the machine for hobbing operations was due to the inaccessibility of shoulder *D* of the worm-wheel as a measuring point for locating the center of the hob. This trouble was overcome by employing the simple indicator attachment shown in the illustration.

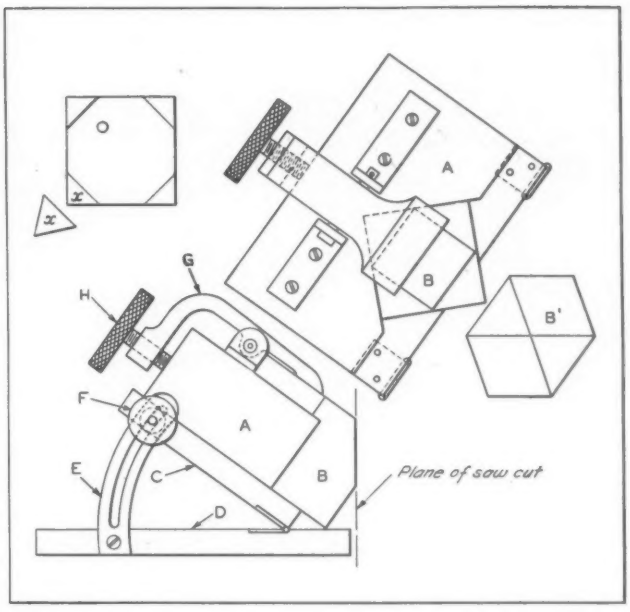
The attachment was secured to the front of the hobbing machine by studs and dowel-pins *E*. Plate *F* holds the indicating stud *S* and arm *G* on which indicator *I* is mounted. The actual dimension from the shoulder *D* of the hub to the outer rim of the wheel—in this case 0.187 inch—is marked on the work by the inspection department. This facilitates determining the accurate dial reading required for locating the work on the vertical center line of the hob.

Arm *G* is swung into the position shown by the dotted lines in the view in the upper right-hand corner of the illustration for locating the work on the vertical center line of the hob. After being located in this manner, the work is fed into contact with the hob. The set-up described has proved very satisfactory where girl operators are employed.

Fixture Designed for Making Fourteen-Sided Block

By JAMES H. RODGERS, Toronto, Canada

Having a quantity of small 1/4-inch cubes of wood and Catalin from which it was desired to remove the corners so as to produce fourteen-sided blocks, the writer devised the fixture shown in the accompanying illustration. This fixture provides a simple, convenient means for accurately positioning and holding the cubes while cutting off the corners. The surface of each corner, when cut off, has the shape of an equilateral triangle, as indicated at *x*.



Fixture Used in Cutting Corners from Cube to Produce Fourteen-sided Block

The fixture is mounted on the table of a metal-cutting saw which is fitted with right-angle gages and clamps, as indicated in the illustration. The feeding movement of the table is parallel to the cutting plane of the saw.

A block of wood *A*, having a 90-degree vee cut at the center of one side to receive the work or cube *B*, is supported by the plate *C*, hinged to the baseplate *D*. Block *A* is secured at the desired angle by means of sector *E* and clamping screw *F*. The cube *B* is firmly pressed into the vee in the block *A* and held in position by the swinging clamp *G*, which is operated by the screw *H*.

When the work is located and clamped at the proper angle, the entire fixture is gradually moved forward until the desired amount of stock is removed from the corner of the cube by the saw. When this lateral adjustment is reached, the baseplate is locked by a machine clamp. Each corner of the work is then removed in succession, the original faces of the cube acting as gaging surfaces for locating the work in the eight different positions. When these operations are completed, the block, as shown at *B'*, has fourteen sides composed of six squares and eight triangles, all edges of which are of equal length.

A uniform variation in shape can be obtained by cutting a smaller amount from the corners, thus leaving smaller equilateral triangular surfaces and six octagonal surfaces in place of the squares, as shown in the view at the upper left-hand corner of the illustration. The length of the side of each of the triangles thus produced is equal to the length of a side of the octagonal surface.

Materials of Industry

THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Plastic "Skin" for Protecting Machine Parts

A translucent "skin" for protecting machine parts in shipment has recently been developed by the Dow Chemical Co. in response to an appeal from a maker of amphibian vehicles. The product, which has an ethyl-cellulose base, is a plastic-like substance which is applied by a simple hot dip process. It sets in a few seconds into a tough, skin-tight coat that fully protects the metal from rust, corrosion, and dirt during shipment. Assembly crews find that it strips off quickly and easily with no more equipment than an ordinary pocket knife. So effective is the material in protecting metal from dirt, salt air, and salt water that parts may even be tossed overboard at high tide near invasion points to be recovered later by repair crews when the tide and the fortunes of war permit. 201

"Mogul"—A Low-Temperature Metallic Flux

A new flux, known by the trade name "Mogul," has been developed by the Metallizing Co. of America, 1330 W. Congress St., Chicago, Ill. This flux is used in soldering and tinning operations to speed up production. It has a lower melting temperature than soft silver solder on initial heats, and once activated, will work at temperatures slightly higher than those used for regular 60-40 solder. Mogul flux is applicable to a wide range of metals, including cast iron, steel, aluminum, and copper. It promotes density of the solder deposit. 202

New Alkali Material for Cleaning Steel

A new alkali material for cleaning steel, called Cleaner 100, is being manufactured by the Enthone Co., 442 Elm St., New Haven, Conn. This product is used in a concentration of from 4 to 8 ounces per gallon in the temperature range of from 180 to 212 degrees F. It is stated to have high detergency and rapid cleaning action even at low current densities. This material is best used anodically, but it is claimed to be an effective immersion cleaner also. The product contains no soap, but does contain complex phosphates that aid in dissolving any fatty soap that may form from greases and oils on the surface being cleaned. The cleaner is equally effective in both soft and hard water, and does not form insoluble residues due to reaction with acids. 203

Process for Blackening and Protecting Zinc Surfaces

A process designated "Alronox" for blackening and protecting zinc surfaces has been developed by the Alrose Chemical Co., Providence, R. I. The blackening operation is conducted in a bath of Oxidine Z salts, manufactured by this company. The part to be blackened is immersed in the bath for about one to two minutes at 212 degrees F. 204

Method of Treating Precision Gages to Indicate Wear

A patent has been granted to A. J. Mitchell, of the Mitchell-Bradford Chemical Co., Bridgeport, Conn., manufacturer of protective coatings, for a method of treating steel precision gages that provides visual control of wear, protection against corrosion from handling, visual inspection of flaws and cracks, and protection against tampering. A gage so treated is first blackened in a Black Magic bath to a depth of penetration approximating 0.0001 inch, and is then given a coating of Witch Dip wax. After this treatment, the gage is placed in service and used until the bright steel shows through the blackened surface. It is then laid aside for checking, and if the entire wear tolerance has not been used up, it may be reblacked and again placed in service. 205

To obtain additional information on materials described on this page, see lower part of page 192.

Cutting Fluids for Machining Operations

The Important Functions and Classes of Cutting Fluids and Their Application in Machining Different Materials

THE function of a cutting fluid varies somewhat for different metal-cutting operations, but, in general, the fluid serves to prevent excessive heating of the tool and work (especially when removing metal rapidly in taking roughing cuts), and by reducing friction and heat generation, prevents excessive tool wear and, in many cases, warpage of the work by localized heating. In screw machine or turret lathe work, and in certain other cases, improvement in surface finish is also an important function of the cutting fluid. Washing away of chips is another function, especially in deep-hole drilling, grinding, milling, and cutting-off operations with power-driven saws. In selecting the cutting fluid, protection of machined surfaces against corrosion may be an important factor; on some machine tools, the fluid is selected to perform the usual function of a cutting fluid and, at the same time, to serve as a lubricant for slides located near the cutting tools.

Many different kinds of cutting fluids have been used. In general, if *cooling* effect is required chiefly, an oil-and-water emulsion is used, but if lubrication of chip bearing surfaces must be combined with cooling, some mineral oil combination is employed. Between these extremes there are many border-line cases, and, consequently, differences of opinion exist. There are no fixed rules or formulas for selecting cutting oils, except the rule of actual test with a given tool or operation and material.

Emulsifying or Soluble Oils

Soluble oils are extensively used for machining operations, particularly when an inexpensive cooling medium meets practical requirements. When an emulsifying oil is mixed with water, an emulsion is formed rather than a solution, but the name "soluble oil" has been generally accepted because the oil apparently dissolves or goes into solution with the water. To obtain a mixture of oil and water, an emulsifying agent is required, and soap has proved to be very effective for this purpose. The emulsion formed contains an infinite number of minute and invisible oil particles, which give the mixture a milky or creamy white color. The proportions of the mixture should be determined by test. If the mixture is too weak, it may cause corrosion of both work and machine. The mixture may range from 1 part of soluble oil to 5 parts of water up to 1 part of soluble oil to 50 or even 100 parts of water.

Soluble oils are easily mixed; but since the emulsion is of the oil-in-water type, it should always be prepared by pouring the *oil* into the water instead of pouring the water into the oil. The emulsification is aided at temperatures somewhat above 40 degrees F., but the use of boiling water may have a reverse tendency. Agitation or stirring increases the emulsifying tendency unless too violent, when there may be a reverse tendency. Even though a soluble oil may serve readily with hard water, it may be desirable to soften the water in order to obtain one of the leaner mixtures or to eliminate scum formation. To prevent corrosion when a soluble oil is used, there should be sufficient air circulation so that the water will evaporate from the machined surface, thus leaving the oil to form a protective coating. If rapid drying is prevented, either by lack of air circulation or by high humidity, rusting is likely to occur.

Paste Compounds—Emulsions may be formed by mixing paste compounds with water. A paste made of saponified mineral oil with a high soap content has the consistency of grease. Paste compounds are not used as extensively as soluble oils, but they are often applied, particularly in connection with grinding operations. These paste compounds do not emulsify with water as readily as the soluble oils and this is especially true with hard water. Hot water and steam may be required in some cases to obtain best results.

Straight Cutting Oils

Straight cutting oils may be in the mineral class or in the fatty or animal class (lard oil).

Straight Mineral Oils—The chief use of mineral oils in connection with machining processes is for blending with base cutting oils to obtain whatever properties are required for different machining operations. Straight mineral oils are applicable to light machining operations, especially on non-ferrous metals, or the machining of free-cutting steel, particularly if both cooling and lubricating effects are required. The low viscosity grades are preferable because of their cooling and penetrating properties. Straight mineral oils are sometimes used on automatics in preference to an emulsion which might interfere with proper lubrication of adjacent machine slides or other parts.

Straight Fatty Oils—Straight fatty oils have in the past been used quite extensively, especially for the heavier machining operations, but certain objectionable features have resulted in the substitution of other cutting fluids. The cost of a fatty oil, such as lard oil, is not only high, but a straight animal oil tends to become rancid and produce an objectionable odor. Bacteria breed in such oils and cause skin troubles among machine operators. Sulphurized cutting oils have supplanted fatty oils to a considerable degree for machining operations requiring chip lubrication. Fatty oils, however, may be used in cases where a sulphurized mineral oil would tarnish the machined parts.

Mineral Lard Oil

Mixtures of mineral oil and lard oil may be used to obtain a cutting fluid having greater lubricating value than a straight mineral oil and much lower cost than a straight lard oil. They may be used when the chip pressures are moderate. The proportion of lard oil and mineral oil depends upon the character of the machining operation and the need for both cooling and lubricating effects. For light machining, straight mineral oil may be satisfactory; for heavier duty or where the metal is removed at a comparatively high rate, the mineral oil may contain from 10 to 40 per cent of lard oil. As a general rule, the percentage of lard oil is increased with the hardness of the stock to be machined. The No. 1 or prime lard oil is the most commonly used animal fatty oil. There are, however, synthetic fatty oils which are used in conjunction with mineral oils to obtain the so-called mineral lard oils. Mineral lard oils are frequently used in connection with automatic screw machine practice. The Saybolt viscosity (which is controlled by the mineral oil) generally varies from 150 to 225 seconds at 100 degrees F. for the blended oil.

Sulphurized and Chlorinated Cutting Oils

The oils in these two general classes are especially useful when there is high chip-bearing pressure, as in machining alloy or other tough steels. The sulphurized and chlorinated base oils are blended with mineral oils and produce metallic oxides or a *metallic*-film lubrication instead of fluid-film lubrication, as a result of the heat generated by the cutting tool. While mineral oils may contain natural sulphur, this has little or no value in cutting oils. There are two methods of adding sulphur. The sulphur may be cooked in and bonded with a fatty oil, such as lard or sperm oil, thus obtaining a compound or "sulphur base" which is added to the mineral oil. The transparent oils are produced by this method, and the required viscosity is obtained by blending the base with a mineral oil. A second method is to add the sulphur directly to the mineral oil by the application of heat. The result is a dark or opaque oil which is suitable where work visibility is not required, as in pipe threading and miscellaneous roughing operations. Chlorine, like sulphur, is added to mineral oils to obtain cutting fluids suitable for high chip-bearing pressures.

Aqueous Solutions

When the function of a cutting fluid is merely to cool the work and possibly wash away chips, water containing some alkali has often been used, although these aqueous solutions have been replaced quite largely by modern cutting fluids. They do not, of course, provide the lubricating film that is important for many classes of work, and they also cause corrosion of both the work and the machine. These aqueous solutions may contain carbonate of soda, borax, caustic soda, etc. Lard oil and soft soap may also be used to improve the properties. An inexpensive mixture for turning, milling, etc., is made in the following proportions: 1 pound of sal-soda (carbonate of soda), 1 quart of lard oil, 1 quart of soft soap, and enough water to make 10 or 12 gallons. This mixture is boiled for one-half hour, preferably by passing a steam coil through it. If the solution should have an objectionable smell, this can be eliminated by adding about 2 pounds of unslaked lime.

Cutting Fluids for Different Materials and Operations

The selection of a cutting fluid depends on machinability and other factors; hence these recommendations are intended as a guide only.

Steels—If a soluble oil is suitable, use 1 part of oil and 10 to 20 parts of water. Mineral-oil or mineral-lard-oil combinations may be used in preference to soluble oils when the latter tend to corrode the work. When steel is so tough that the pressure on the tool is very high, a sulphurized oil is preferable to an emulsion. In cutting hard steels, an oil containing a small amount of chlorine may be preferable. Sulphur-base cutting oils are also used for low- or medium-carbon steels when visibility of the machined surface is essential.

Brass—For machining brass rod in automatics, soluble oils and mineral lard oils are commonly used. A cutting oil may be preferred to an emulsion, because it not only serves as a cutting fluid, but provides lubrication for adjacent slides or other machine bearings near the cutting area. Common proportions for an emulsion are: Soluble oil 1 part, water 20 to 25 parts. Mineral lard oil may contain 5 to 10 per cent lard oil. Cast brass is usually machined dry.

Monel Metal—In turning Monel metal, an emulsion gives a slightly longer tool life than a sulphurized mineral oil, but the latter aids in chip breakage, which frequently is desirable.

Aluminum Alloys—Many different cutting fluids have been recommended such as (1) from 90 per cent kerosene and 10 per cent mineral oil to 50 per cent kerosene and 50 per cent mineral oil; (2) soluble oil emulsion with 15 per cent kerosene; (3) 50 per cent kerosene, 40 per cent lard oil and 10 per cent chlorinated solvent.

Cast Iron—While cast iron ordinarily is machined dry, a soluble oil emulsion may be used to avoid an excessive amount of chip dust.

Turning—For turning steel, soluble oil emulsions, mineral lard oils, and sulphurized cutting oils are used, depending upon the character of the turning operation and the toughness of the steel and resulting chip pressure, as explained previously.

Milling—Soluble oils, mineral lard oils, and sulphurized oils are used, depending upon the machinability of the metal. Soluble oils usually consist of 1 part oil and 10 to 25 parts water.

Drilling—For light or ordinary drilling in steel, use a soluble oil emulsion consisting of 1 part of oil and 25 to 50 parts of water; for heavy-duty drilling, use a sulphurized cutting oil of 100 to 200 Saybolt viscosity at 100 degrees F., containing 1/2 to 2 per cent of active sulphur.

Tapping—For soft or ductile steel, use a sulphurized cutting oil containing 2 to 4 per cent of active sulphur, and for the harder steels a chlorinated cutting oil.

Thread Cutting—For steel, use either 1 part of soluble oil and 15 parts of water or a sulphurized cutting oil containing 2 to 4 per cent of active sulphur with Saybolt viscosity varying from 125 to 300 at 100 degrees F. For copper alloys, use a sulphurized oil of 75 to 100 Saybolt viscosity at 100 degrees F containing 1/2 to 1 per cent of active sulphur. For aluminum and magnesium alloys, use a sulphurized oil of 35 to 50 Saybolt viscosity at 100 degrees F. These are general recommendations only.

Grinding—Soluble oil emulsions or emulsions made from paste compounds are used extensively, although mineral oils are employed in some cases to improve the quality of the ground surface. For cylindrical grinding, use 1 part of soluble oil and from 70 to 80 parts of water; for centerless grinding, use 1 part of oil to 50 parts of water. Mineral oils are used with vitrified wheels, but are not recommended for wheels with rubber or shellac bonds.

Broaching—For steel, use a heavy mineral oil, such as sulphurized oil of 300 to 500 Saybolt viscosity at 100 degrees F., to provide both adequate lubricating effect and a dampening of the shock loads. Soluble oil emulsions may be used for the lighter broaching operations.

Cutting Fluids for Machining Magnesium

In machining magnesium, it is the general, but not invariable, practice in the United States to use a cutting fluid, whereas, in England, magnesium usually is machined dry, except in cases where the heat generated by high cutting speeds would not be dissipated rapidly enough without a cutting fluid. This condition may exist when, for example, small tools without much heat-conducting capacity are employed on automatics.

The cutting fluid for magnesium should be an anhydrous oil having, at most, a very low acid content. Various mineral-oil cutting fluids are used for magnesium. To secure adequate cooling, the supply of fluid should be large (4 to 5 gallons per minute) and the viscosity low; however, to avoid too low a flash point, a compromise between cooling capacity and flash point is required. *Soluble oils or emulsions should never be used for machining magnesium.* Compressed air may be preferable to a fluid, because it leaves the chips or swarf clean and dry.

In machining magnesium, it is important to use very sharp tools with polished chip-bearing surfaces, or polished flutes in the case of drills. The feed should always be coarse enough to avoid any light skimming cuts, as the latter may cause a spark and ignite the fine swarf or chips. Use narrow lands with sufficient relief to prevent dragging of the land heel.

Grinding Magnesium—As a general rule, magnesium is ground dry. The highly inflammable dust should be formed into a sludge by means of a spray of water or low-viscosity mineral oil. Accumulations of dust or sludge should be avoided. For high-finish surface grinding, a low-viscosity mineral oil may be used.

Cutting Fluids for Use with Carbide Tools

Both soluble oils and sulphurized or chlorinated oils are used with carbide tools. A soluble oil emulsion, if supplied in sufficient quantity, is excellent as a cooling medium, but in some cases, the lubricating effect of a cutting oil is desirable. If oil is objectionable because of smoking, a larger volume may be required. Some contend that sulphurized and chlorinated oils tend to weaken the binder and loosen the carbide tips; others believe that fatigue or the high temperatures generated affect the binder.

Cutting fluids should be applied where the cutting action is taking place and at the highest possible velocity without causing splashing. As a general rule, it is preferable to supply from 3 to 5 gallons per minute for each single-point tool on a machine such as a turret lathe or automatic. The temperature of the cutting fluid should be kept below 110 degrees F. If the volume of fluid used is not sufficient to maintain the right temperature, provide cooling means.

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Fastening Devices

AMERICAN INSTITUTE OF BOLT, NUT AND RIVET MANUFACTURERS, 1550 Hanna Bldg., Cleveland 15, Ohio. Publication entitled "Fasteners," which will be issued periodically and will contain articles dealing with technical problems in connection with the application and use of headed and threaded products. Available to design engineers and operating executives. 1

Grinding Wheels for Carbide-Tipped Tools

WALTHAM GRINDING WHEEL CO., 16 Emery St., Waltham, Mass. Bulletin 12, containing complete specifications for steel plate mounted grinding wheels for carbide-tipped tools, as applied to different types of tool-grinding machines. Also, list of straight grinding wheels for sharpening carbide tools. 2

Standard Drilling Machines for Special Purposes

DELTA MFG. CO., 620x E. Vienna Ave., Milwaukee 1, Wis. Publication entitled "Blue Book for Management, Shop, and Production Engineers," presenting the case histories of 140 special-purpose drilling machines built up of Standard Delta-Milwaukee machines and parts to expedite production. 3

Optical Measuring Equipment

ENGINEERS SPECIALTIES DIVISION OF UNIVERSAL ENGRAVING AND COLORPLATE CO., 588 Monroe St., Buffalo, N. Y. Bulletin 1-44ER, covering radius and protractor charts and projector scales and rules for use on optical comparators, measuring projectors, and micro-projectors. 4

Lubrication

SUN OIL CO., 1608 Walnut St., Philadelphia 3, Pa. Technical Bulletin B5, on lubrication of industrial machinery, covering fundamentals of lubrication; types of bearings and gears; selection, application, and purification of lubricants; and lubrication recommendations. 5

Zinc-Alloy Die-Castings

NEW JERSEY ZINC CO., 160 Front St., New York 7, N. Y. 64-page bulletin containing technical data on Zamak alloys for zinc-alloy die-castings, based on years of investigation. It covers properties; aging changes; die design; finishing; and machining and assembling. 6

Electronic Instrument for Sorting Metals

ALLEN B. DUMONT LABORATORIES, INC., Passaic, N. J. Circulars on the DuMont Cyclograph, an electronic instrument for checking, evaluating, and automatically sorting metals and alloys by a non-destructive method. 7

Dust Collectors, Spray Booths, Washing Equipment, Etc.

NEWCOMB-DETROIT CO., 5741 Russell St., Detroit 11, Mich. Catalogue and handbook of engineering data, covering dust collectors, paint spray booths, metal parts washers, drying ovens, and other sheet-metal equipment. 8

Surface Plates, Parallels, Straightedges, Etc.

MACHINE PRODUCTS CORPORATION, 6771 E. McNichols Road, Detroit 12, Mich. Catalogue on the line of shop equipment made by this concern, including surface plates, angles, parallels, V-blocks, straightedges, etc. 9

Tube Couplings and Fittings

PARKER APPLIANCE CO., 17325 Euclid Ave., Cleveland 12, Ohio. Wall Chart showing the various types of pipe fittings and hose couplings made by this company, with tables giving the equivalent fittings in different types. 10

Tool Steel Data

CRUCIBLE STEEL CO. OF AMERICA, 405 Lexington Ave., New York City. Booklet entitled "Tool Steel for the Non-Metallurgist," covering characteristics, purposes for which the different types are adapted, and suggestions for heat-treatment. 11

Grinding Wheels

ABRASIVE CO., Tacony and Fraley Sts., Philadelphia 37, Pa. Booklet containing list prices and other data on mounted grinding wheels and mounted points. Folder containing information on wheels for grinding cemented carbides. 12

Turret Punch Presses

WIEDEMANN MACHINE CO., 1815 Sedgley Ave., Philadelphia 32, Pa. Bulletin 101, on Wiedemann turret punch presses and gage tables for material positioning, especially applicable to short-run piercing operations. 13

Air Drying and Purifying Equipment

LOGAN ENGINEERING CO., Chicago 30, Ill. Bulletin 543-A, on the "Aridifier," a device for removing moisture, dirt, and oil from compressed air. 14

Broach Heads

AMERICAN BROACH & MACHINE CO., DIVISION OF SUNDSTRAND MACHINE TOOL CO., Ann Arbor, Mich. Circular covering all types of broach pull- and push-heads made by this concern. 15

Ball Bearings

NEW DEPARTURE DIVISION GENERAL MOTORS CORPORATION, Bristol, Conn. Booklet entitled "Making Them 'Round'," describing how New Departure steel balls are made. 16

Carbide-Tipped Tools

CLEVELAND TWIST DRILL CO., 1242 E. 49th St., Cleveland, Ohio. Catalogue listing dimensions and prices of Cleveland carbide-tipped high-speed reamers and counterbores. 17

Unichrome Copper Plating

UNITED CHROMIUM, INC., 51 E. 42nd St., New York 17, N. Y. Bulletin entitled "Unichrome Alkaline Copper Plating for Fast Production and Smooth, Ductile Deposits." 18

Molds for Plastics

MIDLAND DIE & ENGRAVING CO., 1800 Berenice Ave., Chicago 13, Ill. Booklet entitled "Shaping Tomorrow Today," showing how this concern produces molds for plastic parts. 19

Diamond Grinding Wheels

LARCO TOOLS, Plant Service Department, 551 Fifth Ave., New York 17, N. Y. Booklet containing data on uses, operation, and maintenance of diamond-impregnated metal-bonded grinding wheels. 20

Hydraulic Drilling Units

BARNES DRILL CO., 814 Chestnut St., Rockford, Ill. Bulletin 150, descriptive of Barnsdril new hydraulic units for special drilling, reaming, facing, boring and tapping operations. 21

Precision Gage-Blocks

CONTINENTAL MACHINES INC., 1301 Washington Ave. S., Minneapolis 4, Minn. Folder entitled "Jewels of Industry," illustrating applications of DoAll precision gage-blocks. 22

Bending Presses

CLEVELAND CRANE & ENGINEERING CO., 1157 E. 283rd St., Wickliffe, Ohio. Catalogue 2010-A, on Cleveland Steelweld bending presses and bulldozers, showing a variety of applications. 23

Tapping Machines

CLEVELAND TAPPING MACHINE CO., Cleveland, Ohio. Circulars 3-43 and 7-42, descriptive of Cleveland Model DB and Model D lead-screw controlled automatic tapping machines. 24

Speed Reducing Transmissions

D. O. JAMES MFG. CO., 1140 W. Monroe St., Chicago, Ill. Catalogue 1000R, containing 376 pages of data on speed reducing transmissions and cut gears. 25

Cutting Oils

D. A. STUART OIL CO., LTD., 2739 S. Troy St., Chicago 23, Ill. Booklet entitled "Soluble Cutting Oil at its Best," discussing typical problems involved in the selection and application of water-mix oils. 26

Bolts and Nuts

LAMSON & SESSIONS CO., Cleveland, Ohio. Booklet entitled "Bolts are Important," containing information of aid in selecting the right bolt and nut for a given application. 27

Screw Machine Attachment for Engine Lathes

RAY MFG. CO., 2324 W. 7th St., Los Angeles 5, Calif. Circular K-B 101, descriptive of the Ray automatic screw machine attachment for engine lathes. 28

Tungsten-Carbide Tool Blanks

TUNGSTEN CARBIDE TOOL CO., 2661 Joy Road, Detroit 6, Mich. Bulletin 44-2, containing a list of the sizes of standard Carboloy tungsten-carbide tool blanks in stock; prices are included. 29

Diamond Wheel Dressers

WILLEY'S CARBIDE TOOL CO., 1340 W. Vernor Highway, Detroit 1, Mich. Catalogue 41, explaining the features of design of Willey's diamond mechanical wheel dressers. 30

Indexing and Holding Fixtures

ZAGAR TOOL, INC., 23880 Lakeland Blvd., Cleveland 17, Ohio. Cir-

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Tungsten-Carbide Jig Bushings

METAL CARBIDES CORPORATION, Youngstown 5, Ohio. Catalogue JB-44, containing prices and specifications covering standard Talide tungsten-carbide jig bushings. 33

Flexible Couplings

FARREL-BIRMINGHAM CO., INC., 344 Vulcan St., Buffalo, N. Y. Bulletin describing Farrel Manger flexible couplings designed for use where space is limited. 34

Heat-Treatment Methods

E. F. HOUGHTON & CO., 303 W. Lehigh Avenue, Philadelphia 33, Pa. Treatise entitled "Interrupted Quench in Salt," in the March issue of *Production Data*. 35

Tool-Steel Tubing

BISSETT STEEL CO., 945 E. 67th St., Cleveland 8, Ohio. Leaflet entitled "How Tool Steel Tubing will Save You Time, Money, Manpower, and Metal." 36

Thyratron Welding Control

GENERAL ELECTRIC CO., Schenectady, N. Y. Circular GEA-4207, descriptive of a current regulating compensator for G-E thyratron welding control. 37

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HOEFER MFG. CO., INC., Freeport, Ill. Bulletin entitled "Passport to Progress," showing different styles of multiple drilling heads for a variety of needs. 38

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HYDRAULIC PRESS MFG. CO., Mount Gilead, Ohio. Bulletin containing information on the H.P.M. closed-circuit system of operating Fastraverse hydraulic presses. 40

Hole Punching Units

WALES - STRIPPIT CORPORATION, North Tonawanda, N. Y. Catalogue E, illustrating and describing Wales Type E hole punching units for shaped or extruded sections. 41

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WELTRONIC CO., 20735 Grand River Ave., Detroit 19, Mich. Folder containing information on the Weltronic synchronous resistance-welder control. 42

Spotlight for Riveting

SCIAKY BROS., 4915 W. 67th St., Chicago 38, Ill. Bulletin 203-A, describing the Sciaky Spotlight for locating work accurately in performing blind riveting or other blind operations. 43

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GARRISON MACHINE WORKS, INC., Dayton 7, Ohio. Circular illustrating various applications of Garrison "Pitch Line Control" gear chucks. 47

Automatic Control Instruments

BRISTOL CO., Waterbury 91, Conn. Circular entitled "Instruments for Automatic Control of War-Time Processes and Operations." 48

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 194-216 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in May, 1944, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on page 186, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning name of material as described in May, 1944, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.

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Detach and mail to MACHINERY, 148 Lafayette St., New York 13, N. Y.

[SEE OTHER SIDE]

FOR ACCURATE AND FAST GRINDING

···INSTALL Nº 5's *NOW*

ON CLOSE-TOLERANCE HIGH-PRODUCTION JOBS — many users of No. 5's are maintaining steady production to .0001" limit and fine micro-inch readings.

STURDY PRECISION CONSTRUCTION and ease of operation mean getting out the work on time and ACCURATELY. **Recessed base** (originated by Brown & Sharpe) permits working in a sitting position with the same convenience and rapidity of operation as when standing.

The Brown & Sharpe No. 5 Plain Grinding Machine is ideal for small parts production grinding. Besides regular table travel as standard the machine may be ordered with the following additional equipment — independent automatic cross feed (for straight-in-feed grinding) — wheel slide rapid travel — and wheel spindle reciprocating arrangement. We can make prompt shipment.

BROWN & SHARPE

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Bullard Mult-Au-Matic Built to Handle Large Work

A Mult-Au-Matic of larger size than any previously available has just been brought out by the Bullard Co., Bridgeport 2, Conn. This new machine will handle work up to 34 inches in diameter by 23 inches in height. The larger capacity of the new machine permits component parts of airplane engines, marine power units, tanks, transmissions, and similar work to be machined by the familiar Mult-Au-Matic production methods employed in the automotive and allied industries prior to the war.

Although this 34-inch machine operates on the same basic principles as preceding Mult-Au-Matics, it is of more massive construction and has new features designed to machine larger parts. Labor-saving features include power-operated chucks and push-button control for both forward and backward motion of the tool-slides.

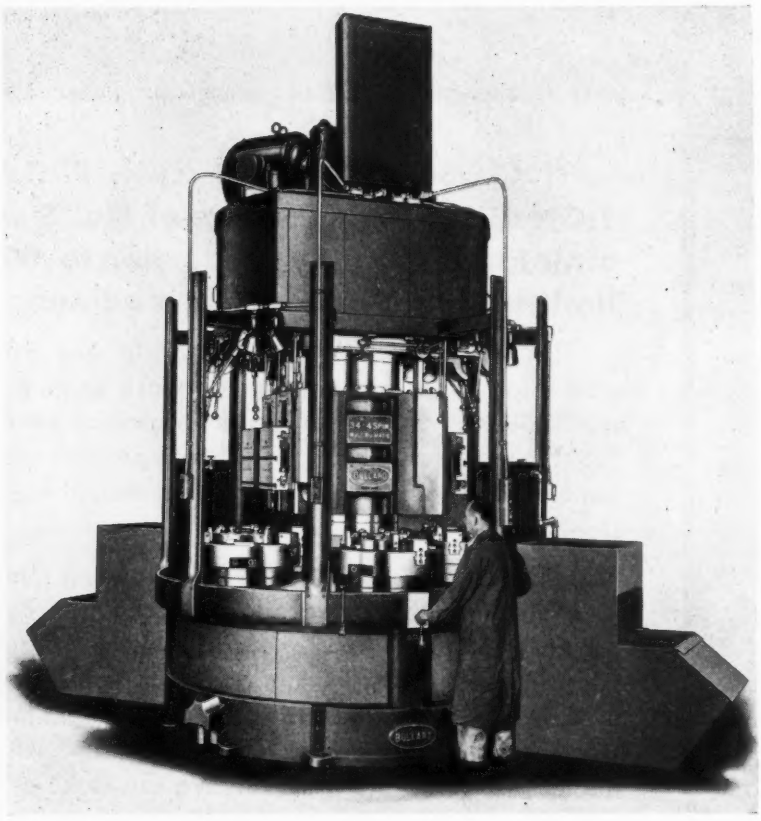
Six heads—two at each working station—each having independent feeds and a vertical movement of 8 inches, a horizontal movement of 5 3/8 inches, or an angular motion, make it possible to accomplish with three working stations, work that formerly required six stations. All heads are counterweighted hydraulically, means being provided to adjust the amount of counterweighting. A specially designed indexing and locking mechanism provides smooth indexing, rigid positioning, and secure locking of the carrier at the completion of each indexing movement. A hydraulic "kick-out" for each feed prevents breakage of carbide tools when the machine is stopped on incomplete cuts.

The adjustable column which carries the tool-heads permits moving all six heads up or down together as a unit. The column is adjusted by power on the cylindrical center column, and is provided with a clamping device and lock-pin. This arrangement allows height adjustments for most advantageous positioning of the heads, reduces overhang of tools, and provides full bearing surfaces for the head slides at all times.

The three-jaw chucks furnished as standard equipment are hydraulically operated by a separate pump and motor. Special hydraulically operated fixtures can be designed to meet work requirements. One of the four spindles is always in the loading position, while the other three are in operation. The spindles are mounted on preloaded Timken bearings and are equipped with brakes.

A dual speed range provides a choice of low speeds for slow, heavy cuts or higher speeds for small-diameter work. With this arrangement, one or two spindles can be operated at low speed while the others are operating in the high-speed range, or vice versa. A fluid motor drive at the loading station can be used to jog the spindle for "targeting" or indicating.

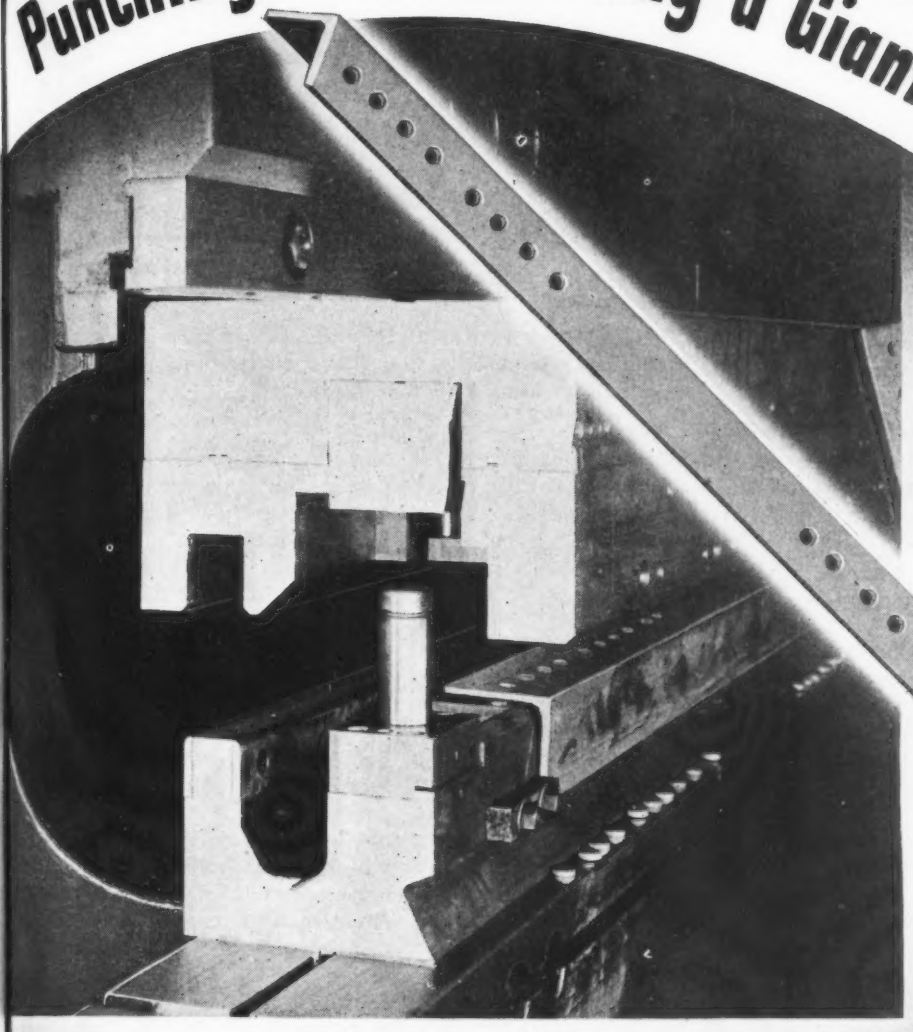
The two standard ranges of machine spindle speeds are 2.8 to 25.2 R.P.M. and 17 to 153 R.P.M. A third range of 33 to 299 R.P.M. is available on special order. There



Large-size Mult-Au-Matic Brought out by the Bullard Co. for the Mass Production of Parts Requiring Larger Work-handling Capacity than that Provided by Previous Machines

To obtain additional information on equipment described on this page, see lower part of page 192

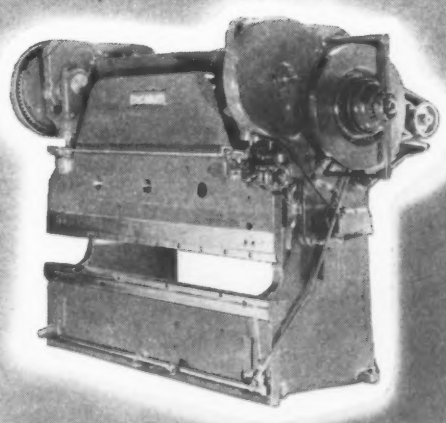
Punching and Trimming a Giant "Mechano" Set...



With this giant version of "Little Willie's" Christmas toy, U. S. engineers restore devastated port handling facilities or create new ones with magic speed.

On this punching and trimming job holes must match up and edges must be true—Accuracy is a first consideration. The machine tool-like performance of Cincinnati Press Brakes does the job smoothly and economically.

For a complete picture of the wide uses of these brakes, write for Catalog B-2.



THE CINCINNATI SHAPER CO.

CINCINNATI OHIO U.S.A.

SHAPERS · SHEARS · BRAKES

are three rates of feed per revolution of the spindle—namely, 0.0246 to 0.3992 inch, 0.0035 to 0.2102 inch, and 0.0027 to 0.1231 inch. A fine feed attachment available on special order provides feeds from 0.003 to 0.0267 inch when used with the first feed range.

Automatic lubrication by pressure and gravity is provided for all bearings and working surfaces except the heads, which are hand-oiled. The coolant is circulated by an auxiliary motor-driven pump from two combination chip and coolant reservoirs. The electric motor equipment consists of a 75-H.P., 1800-R.P.M. main drive motor and seven auxiliary motors.

The base of the machine is 120 inches in diameter, but a floor space of 190 by 190 inches is required to include the two coolant tanks, chip boxes, and motors. The weight of the machine, including heads and chucks, is 80,200 pounds. 51

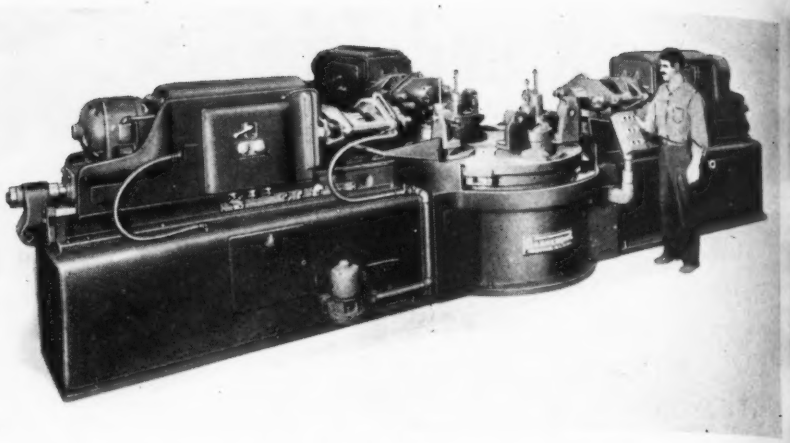


Fig. 3. Barnes Hydraulic Drilling Units Arranged Horizontally around an Indexing Table

Hydraulic Production Drilling Units

The Barnes Drill Co., 814 Chestnut St., Rockford, Ill., recently completed a special hydraulic production drilling unit which can be arranged for drilling, facing, reaming, boring, counterboring, or tapping operations in any one or a combination of horizontal, vertical, or angular positions. The unit is available in three sizes, designated Nos. 5, 10, and 20. Each size is motorized according to the requirements of the job.

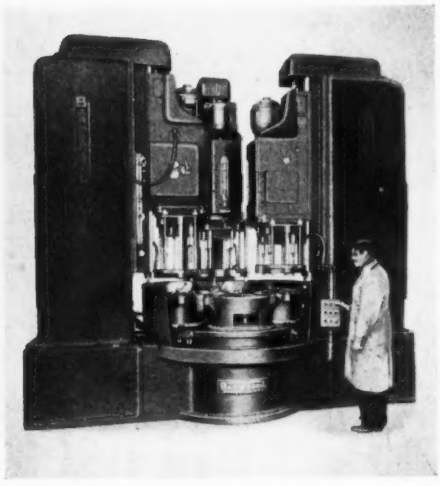
The No. 5 unit is equipped with a 5- to 7 1/2-H.P. motor, the No. 10 unit with a 10- to 15-H.P. motor, and the No. 20 unit with a 20- to 25-H.P. motor. The Nos. 10 and 20 units have the essential number of working parts built in complete with a single motor which drives the spindle, hydraulic pump, and any automatic hydraulic feed cycle equipment. The No. 5 unit has a separate motor-driven hydraulic system, and is arranged to give rapid approach, variable feed, and quick return movements. Maximum, uninterrupted production can be obtained by using the Barnesdril automatic indexing table, with a spare loading station and a hydraulic decelerated control for positioning the table.

Used vertically as a hydraulic production machine, as shown in Fig. 1, the unit is capable of performing simultaneous drilling, reaming, and counterboring operations. These units can also be arranged vertically in combination with angular and horizontal applications. Vertical arrangement of the units around a rotating indexing table permits several operations to be combined.

The units can be arranged for horizontal operations, either as single units grouped around an indexing table, as shown in Fig. 3, or in combination with vertical and angular applications. Each unit has a flange support for interchangeable auxiliary heads of any desired number and arrangement of spindles. One standard unit equipped with an eight-spindle auxiliary head, which is used horizontally as a self-oiling production machine, is capable of facing and counterboring as many as eight bosses simultaneously.

Numerous angular applications of these units are possible. In Fig. 2 is shown a two-spindle No. 10 unit angular drilling machine equipped with two automatically operated hydraulic drilling units, with all essential working parts built in. These two standard units, used in an angular position, can be employed for drilling and counterboring twelve holes in a propeller shaft, two at a time.

The hydraulic system of the built-in motor on the Nos. 10 and 20 units is automatically cooled by a fan blower mounted on the shaft in front of the motor. A motor-driven chip conveyor automatically removes chips from the indexing table and deposits them in a receptacle at rear of machine. 52



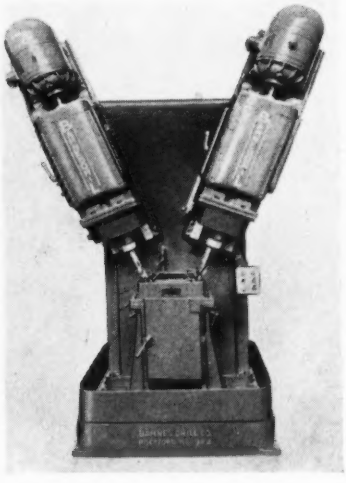
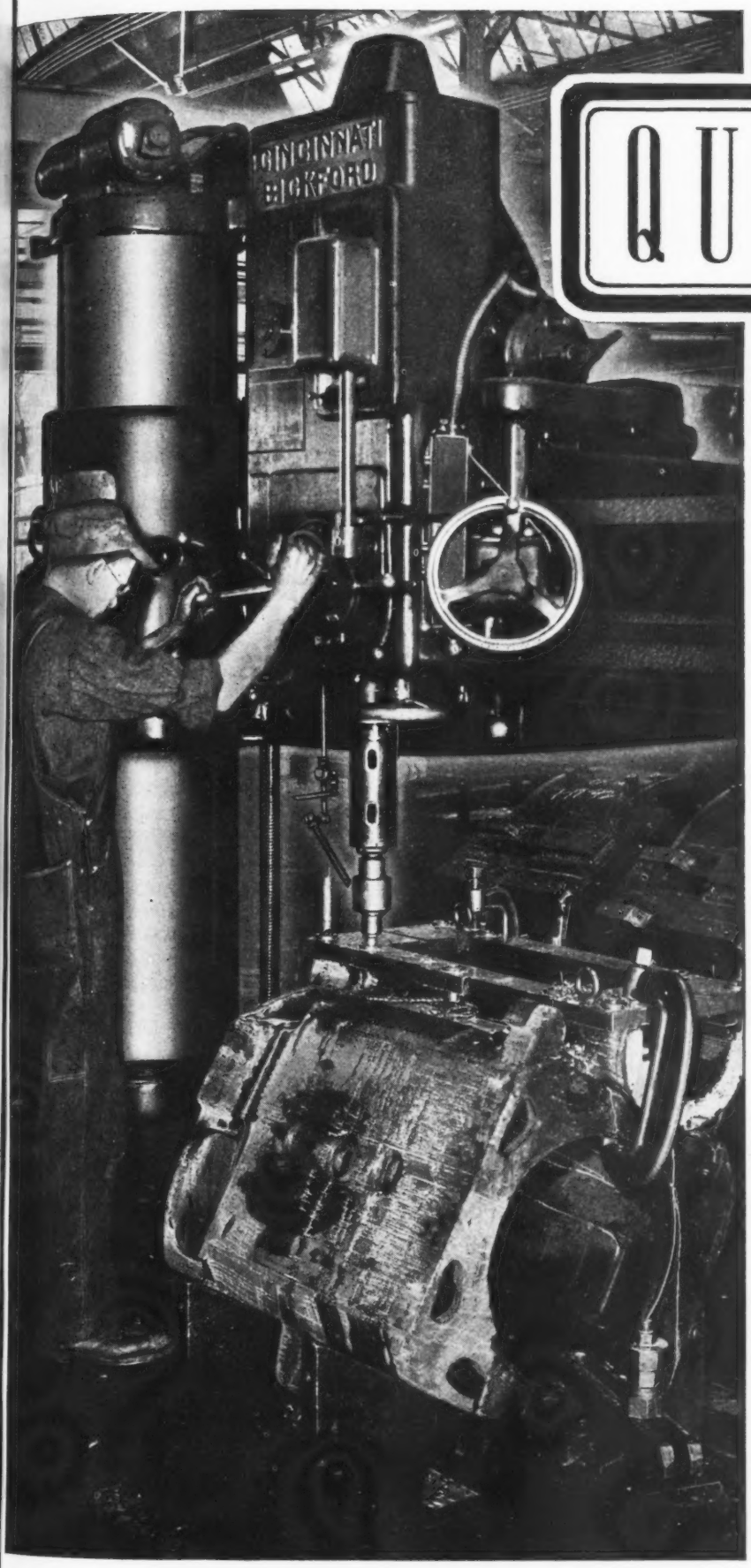


Fig. 1. (Left) Barnes Hydraulic Drilling, Reaming, and Counterboring Machine. Fig. 2. (Right) Two-spindle Angular Drilling Unit

To obtain additional information on equipment described on this page, see lower part of page 192.



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Illustrated is a typical application of the SUPER SERVICE RADIAL to wartime production. The job calls for operations on motor frames for Diesel-electric switcher-engines . . . vital jobs, because the War Department, the Navy Department, Arsenals and many large manufacturers require these engines to speed essential transportation. For work of this character the SUPER SERVICE RADIAL is almost a standard. You'll find these famous Radials on the job, 3-shifts-per-day, 7 days a week, in countless war production plants from coast to coast. The Quality of their design —the Quality of their workmanship and construction — the Quality of their performance is such that the name "Cincinnati Bickford" on a Radial is sufficient to assure top operating speeds, unexcelled accuracy and "more holes per dollar."

THE CINCINNATI BICKFORD TOOL CO. OAKLEY, CINCINNATI, OHIO, U. S. A.

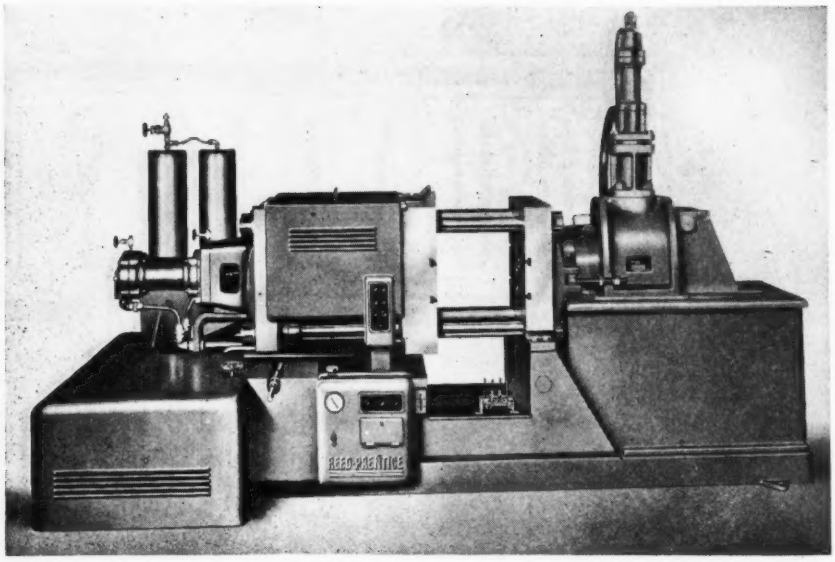


Fig. 1. Reed-Prentice Die-casting Machine Equipped with Melting Furnace for Producing Zinc Castings

Reed-Prentice Die-Casting Machines

Two die-casting machines of improved design have recently been added to the line of the Reed-Prentice Corporation, Worcester 4, Mass. The No. 1 1/2 machine, shown in Fig. 1, is equipped with a melting furnace attachment for the production of zinc, tin, or lead-base alloy die-castings. The No. 1 1/2 G machine, shown in Fig. 2, is equipped with a high-pressure cold chamber for the production of aluminum, magnesium, and brass alloy die-castings. The design of these machines provides for quick change of the melting furnace and cold chamber attachments. The change from one attachment to the other can be accomplished in four or five hours. Either attachment can be purchased separately.

New construction features include a one-piece welded base and hydraulic tank; improved linkage, with electric steel members, nitrided pins, and hardened steel bushings; heavy steel castings for die-plates; improved hydraulic circuit designed to increase speed of operating cycle; and electrically operated hydraulic control with new control panel.

The machines are arranged for both manual and semi-automatic operation. For semi-automatic operation, the dies are closed manually by the push-buttons on the control panel. In the case of the machine equipped with the melting furnace attachment (Fig. 1), the remainder of the cycle is automatic and controlled by an adjustable electric timing device. Operation of the machine shown in Fig. 2, after closing the dies, consists of ladling the metal into the pouring slot in front of the ejector plunger and then stepping on the foot-switch, which causes the plunger to shoot forward. The remainder of the cycle is automatic, and is controlled by an electrical timing device. The plunger remains forward, and when the dies open, it travels an additional 3 1/2 inches to eject the slug.

When the machines are manually operated, the four push-buttons on the control panels are used. The two upper buttons control the opening and closing of the dies, while the two lower ones govern the movements of the plunger. The machines are electrically interlocked to eliminate danger of "shooting" the metal before the dies are closed and securely locked. Arrangements are made for the automatic ejection of castings. The die-plates are finished on the sides for mounting core-pulling attachments. A push-button is provided to actuate the core-pulling cylinders when they are employed.

The No. 1 1/2 machine has die-plates approximately 28 by 29 inches and a melting pot that will hold 700 pounds of zinc. The space between the bars is 15 by 18 inches, and the die opens 10 inches. The maximum die space is 18 inches, and the minimum space 6 inches. The diameter of the die cylinder is 5 1/4 inches. The locking pressure is about 130 tons. The machine is operated by a 15-H.P. motor.

The plunger has a stroke of 7 1/4 inches, and is made in seven diameters ranging from 1 3/4 to 3 1/4 inches. With the smallest diameter plunger, a pressure of 3460 pounds per square inch is exerted on the metal. In this case, the maximum casting area is 57 square inches, the amount of metal per "shot" 5.1 cubic inches, and the weight of the zinc casting produced 1 1/4 pounds. With the largest diameter plunger, a pressure of 1000 pounds per square inch is exerted on the metal. In this case, the maximum area of the casting is 200 square inches and the amount of metal per "shot" 42 cubic inches. With this large plunger, zinc castings up to 10 1/4 pounds can be produced. The

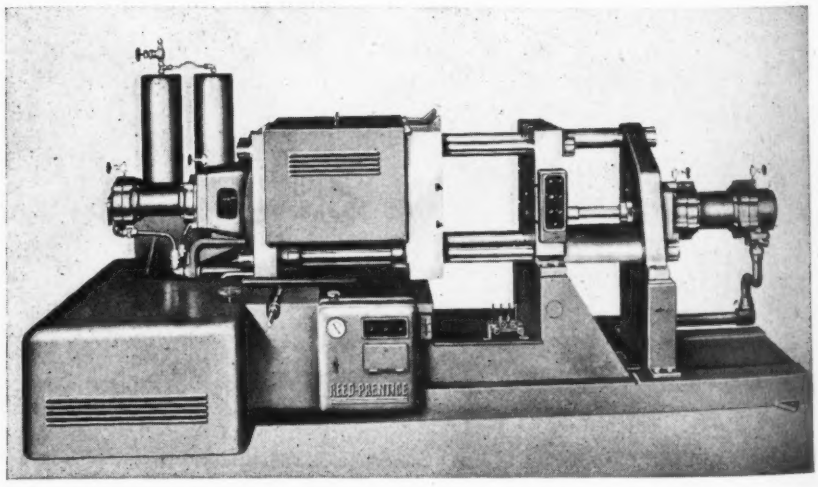
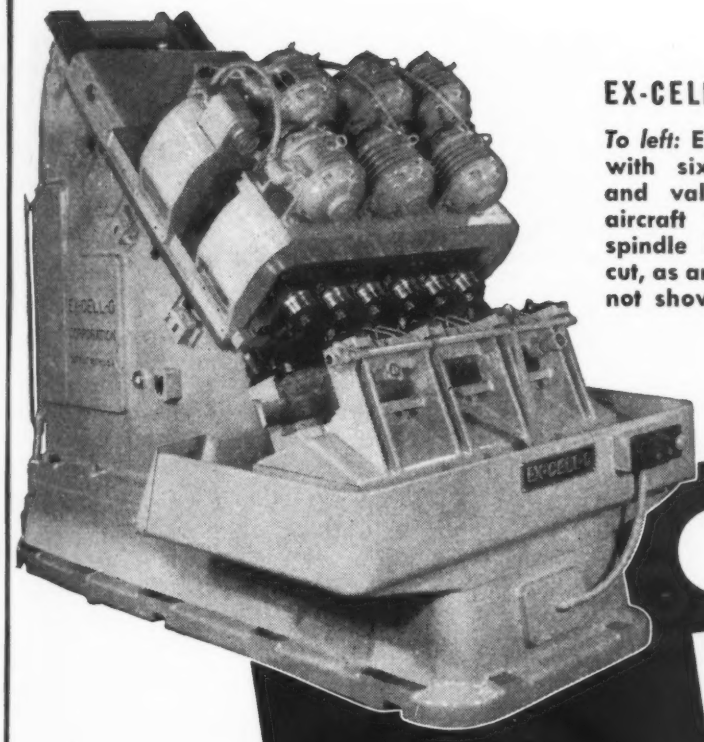


Fig. 2. Reed-Prentice Die-casting Machine with Cold Chamber for Die-casting Aluminum, Magnesium, or Brass Alloys

To obtain additional information on equipment described on this page, see lower part of page 192.



EX-CELL-O CYLINDER BORING MACHINE

To left: Ex-Cell-O angular type machine equipped with six spindles to finish bore valve seats and valve guide holes in cylinder head of aircraft engine on a production basis. Each spindle is individually adjustable for depth of cut, as are the tools in the boring bars (boring bars, not shown in picture, are piloted in the fixture).

SPECIAL MACHINES

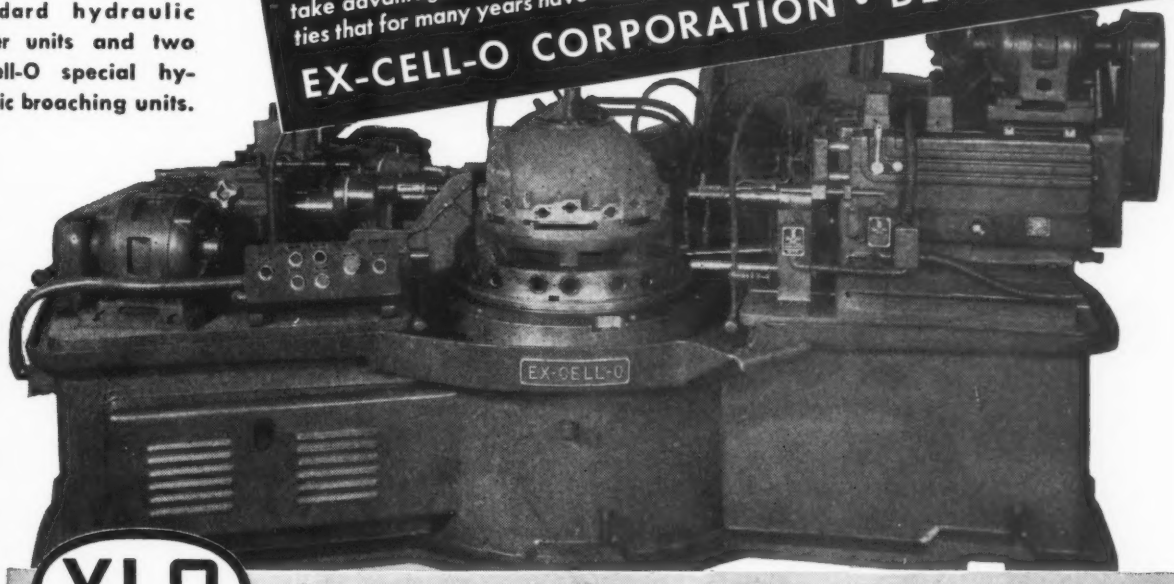
...for today's production...and tomorrow's

For years Ex-Cell-O has been familiarly known as "the headquarters" for special single-purpose machines for turning out accurate parts at a high rate of speed . . . machines that frequently perform numerous operations in one setting of the work and often bring not only a substantial increase in the number of parts produced hourly but also improved quality and reduced unit cost. . . . This is why so many manufacturers have turned to Ex-Cell-O for equipment to meet their war production schedules; why Ex-Cell-O designed machines will figure in the post-war plans of an increasing number of American industries. . . . If you are planning for tomorrow, when the new standards will necessitate costs that are competitive, take advantage of the wide engineering experience and extensive manufacturing facilities that for many years have made Ex-Cell-O a leader in the precision machine tool field.

EX-CELL-O CORPORATION • DETROIT, MICH.

EX-CELL-O SIX-WAY MACHINE

Below: Ex-Cell-O six-way machine for drilling, broaching and reaming valve guide holes in a magnesium crankcase. This machine is equipped with four standard hydraulic power units and two Ex-Cell-O special hydraulic broaching units.



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Precision THREAD GRINDING, BORING AND LAPPING MACHINES • TOOL GRINDERS • HYDRAULIC POWER UNITS • GRINDING SPINDLES • BROACHES • CONTINENTAL CUTTING TOOLS • DRILL JIG BUSHINGS • DIESEL FUEL INJECTION EQUIPMENT PURE-PAK CONTAINER MACHINES • R. R. PINS AND BUSHINGS • PRECISION PARTS

weight of the crated machine is 15,500 pounds.

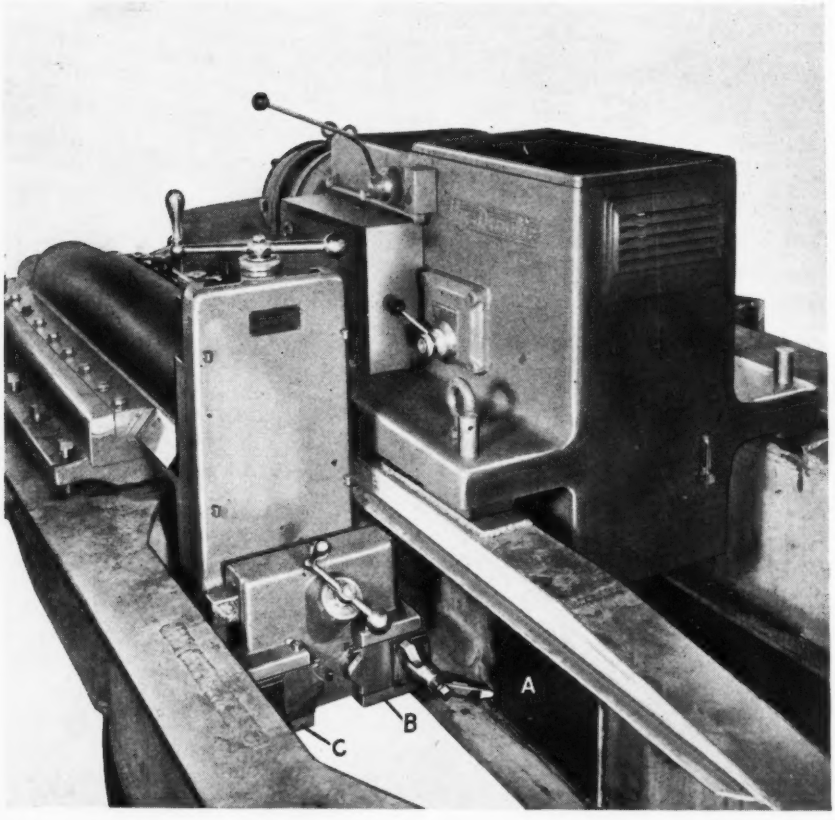
Nine different sizes of plungers are available for the No. 1 1/2 G machine. These range from 1 1/2 inches in diameter up to 2 1/2 inches, covering a range of capacities of from 14 to 39 cubic inches per "shot," with pressures ranging from 16,000 to 5700 pounds per square inch. With the 1 1/2-inch diameter plunger, aluminum castings weighing 1.3 pounds, brass castings weighing up to 4 1/4 pounds, and magnesium castings weighing 0.9 pound can be produced.

The largest plunger diameter regularly used for brass is 1 7/8 inches; this can be used for producing brass die-castings up to 6 1/2 pounds. The 2 1/2-inch diameter plunger can be used for aluminum castings weighing up to 3.75 pounds and magnesium castings weighing up to 2.5 pounds. The pressure available for opening the dies is 200,000 pounds. The weight of this machine crated is 12,500 pounds. 53

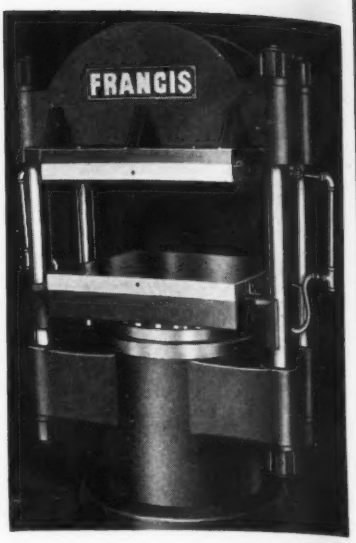
"Hy-Draulic" Shaper for Use on Large Weldment

The Rockford Machine Tool Co., Rockford, Ill., has recently built a special portable "Hy-Draulic" shaper for use in finishing 12- by 12-inch pads located between the flanges of I-beam sections of large weldments. This shaper is equipped with a driving motor, and can be readily raised by an overhead crane and transported to the work. Three eye-bolts are provided on the shaper frame for lifting chains.

After the shaper has been lowered into place on the weldment with its bearing surfaces resting on finished surfaces of the work, locating pins are inserted to align the shaper ram very accurately in the correct position for finishing the pads, one of which can be seen at *A* in the accompanying illustration. Pad *A* is finished by the tool held in the tool-head *B*. A second pad opposite the one at *A* is finished by a tool held in the tool-head at *C*. Clamping bolts are provided for holding the shaper in place during machining operations.....54



Special Portable "Hy-Draulic" Shaper Designed to Finish Pads on a Large Weldment



Hydraulic Press Designed for Adaptability to Individual Needs

Francis General-Purpose Hydraulic Press

A general-purpose hydraulic press designed for adaptability to individual needs has been brought out in four sizes by the Charles E. Francis Co., Rushville, Ind. These presses can be furnished with any number of steam or electrically heated hot plates needed in manufacturing products from plastics, rubber, and other materials which require the application of pressure and heat. The daylight height capacity can be made to suit requirements.

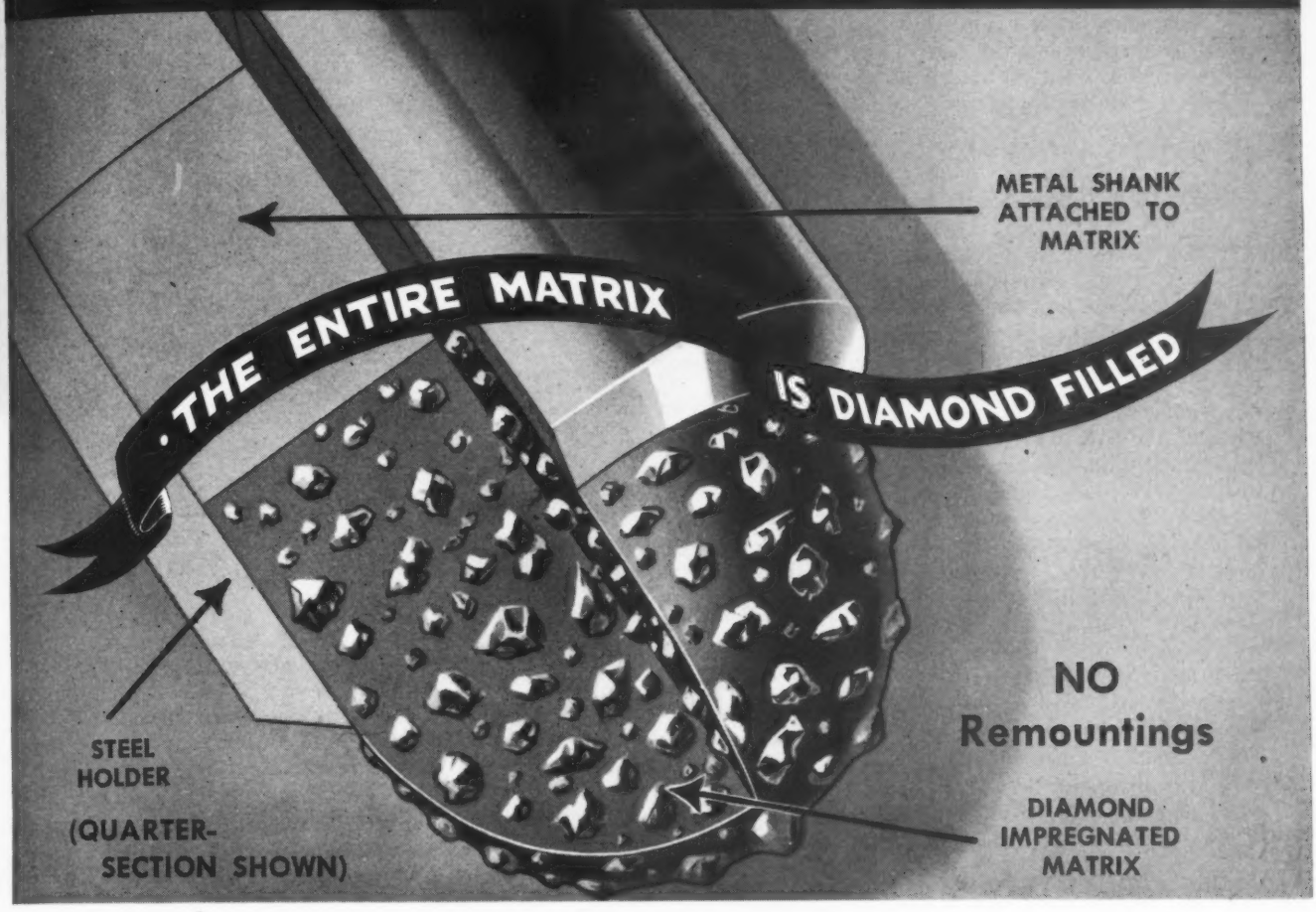
The platen dimensions of the four sizes of presses are 12 by 12, 18 by 18, 24 by 24, and 30 by 30 inches. The standard stroke lengths are 8 inches for the smallest size press, and 14 inches for the other three sizes. The four presses have capacities for exerting pressures of 50, 113, 133, and 153 tons. They weigh 2000, 5000, 7500, and 9000 pounds, and require floor spaces of 18 by 24, 30 by 33, 32 by 40, and 34 by 47 inches. 55

Improved Center Lapping Points

To meet the close tolerances required in thread grinding and other precision grinding operations, the Bay State Abrasive Products Co., Westboro, Mass., has developed "Blue Flash" center lapping points for use in connection with Ex-Cell-O center lapping machines.

To obtain additional information on equipment described on this page, see lower part of page 192.

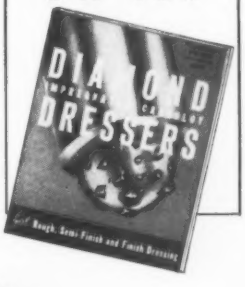
Every Carat Does Extra Duty...in THIS Diamond Dresser!



Every precious carat does extra duty in the diamond-impregnated Carboloy Dresser! You use up to 90% of the diamond content. No unnecessary waste! Each diamond stays on the job continuously throughout a long period of useful life. They *can't* come loose in Carboloy Dressers because they're mounted in a special carbide matrix that has the unique ability to hold even extremely small diamond particles securely.

Try Carboloy Dressers on your next job. You'll save at least 25% in dresser cost, eliminate all remountings, and get uniform, dependable results. Write for folder DR-100.

WRITE FOR CATALOG DR-100



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CARBOLOY CEMENTED CARBIDE DIAMOND DRESSERS IMPREGNATED

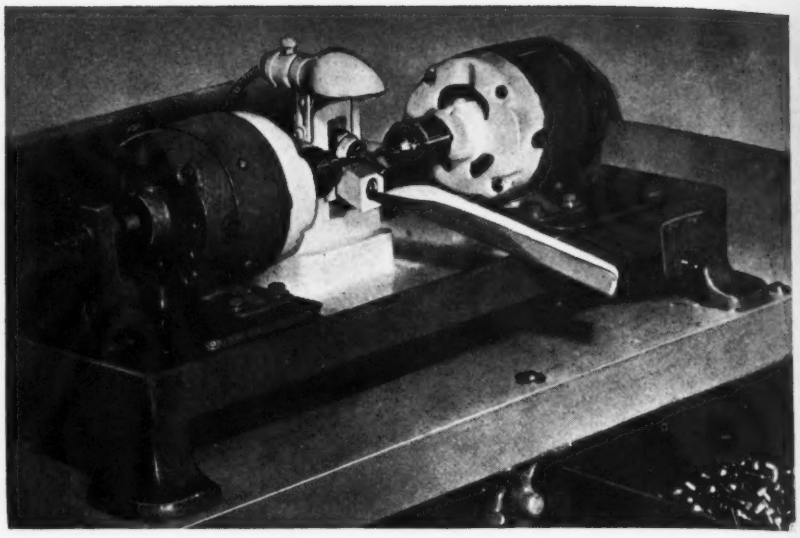
For GENERAL USE ON GRINDING WHEELS

These are made with the same construction features as the regular Bay State mounted wheels and points. The center lapping points need no "breaking in," since they are furnished as a completely finished product, ready for use. They are available in all regular sizes on 1/2-inch mandrels. 56

Mercury Countersinking Machine

The Mercury Products Co., 423 Euclid Ave., Cleveland 14, Ohio, has developed a countersinking machine which has only two rotating members, a work-rest of tungsten-alloy heat-treated steel to eliminate wear, and two 1/6-H.P. motors. It is claimed that this machine occupies one-sixth the bench space generally needed for the kind of work it handles, and that it consumes only one-fifth the power ordinarily required. Unusually high production and substantial savings in labor costs are claimed for this machine.

The new countersinking machine has a heavy cast-iron base, No. 8 1/2 Jacobs super-chucks, heavy toolpost, optional knee or floor pedal control, light over the work-rest, toolpost micromatic adjustment for depth and height, and end micromatic adjustment for depth of countersinking. It is 28 1/2 inches long, 10 1/2 inches wide, 11 inches high, and weighs 70 pounds.....57



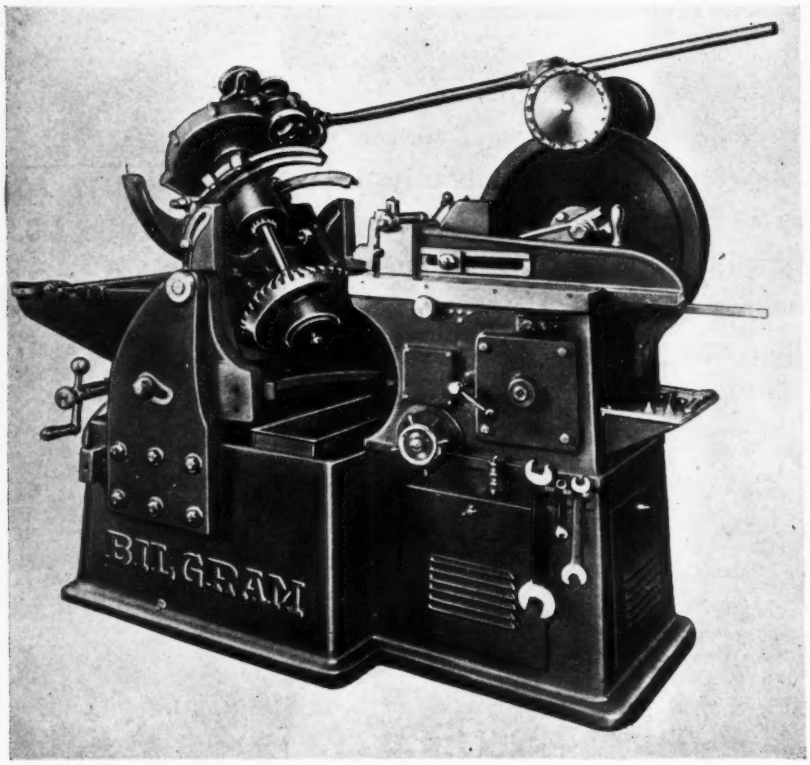
Countersinking Machine Made by Mercury Products Co.

Bilgram Bevel Gear Generator

The Bilgram Gear & Machine Works, 1235 Spring Garden St., Philadelphia 23, Pa., has introduced to the manufacturing industry a new bevel gear generator which is the result of engineering experience gained over a period of sixty-odd years. The generating principle remains the same as in previous Bilgram machines of this type, but its application has undergone many changes.

This new machine is universal in all respects, and is fully equipped to cut involute teeth of 14 1/2- and 20-degree pressure angles, of both straight and spiraloidal types. Teeth of other pressure angles can be cut by making adjustments in set-up. It will cut any gear of ordinary design up to 16 inches outside diameter, 1 to 8 ratio, with a maximum cone distance of 8 1/16 inches, and will generate any tooth, standard or mongrel, from 20 to 2 diametral pitch.

This machine is not only capable of handling gears of ordinary design, but will also accommodate gear blanks having apex hubs which extend up to 6 1/2 inches beyond the apex. It is electrically equipped throughout, driving through an infinitely variable drive of the positive type. This drive allows a variation of speed of from 30 to 108 strokes of the cutting ram per minute. The feed-box built into the machine will produce fifteen feeds for the generating head, which are obtained through a mere twist-of-the-wrist mechanism. 58



Bilgram Universal Bevel Gear Generator

To obtain additional information on equipment described on this page, see lower part of page 192.

Precision on the ground for Performance in the air

SIDNEY LATHES

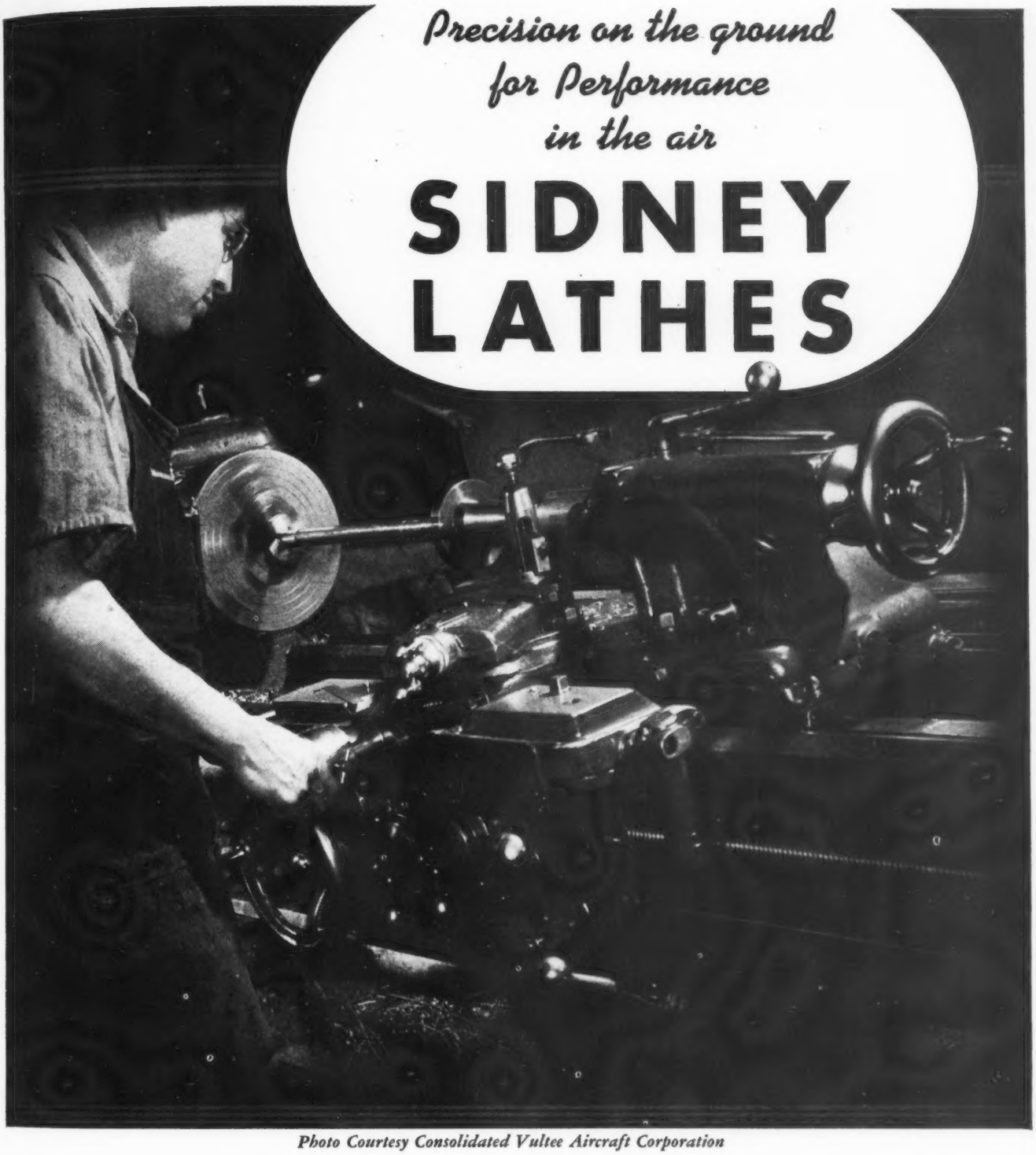


Photo Courtesy Consolidated Vultee Aircraft Corporation

● The every day run of turning jobs require the same precision—the same uniformity—the same high finish as the so called spectacular jobs. • Here a Sidney Lathe at Consolidated Vultee is meeting precision tolerances on a turning operation quickly — easily. • The convenience of controls at normal working position—the wide selection of feeds and speeds instantly available — the smooth flow of power from the continuous tooth Herringbone Geared Headstock all contribute to the accuracy and productivity of this Sidney Lathe. • And it is these Sidney Lathe qualities that make them so popular in the Aircraft Industry.

Bulletins on all sizes available.

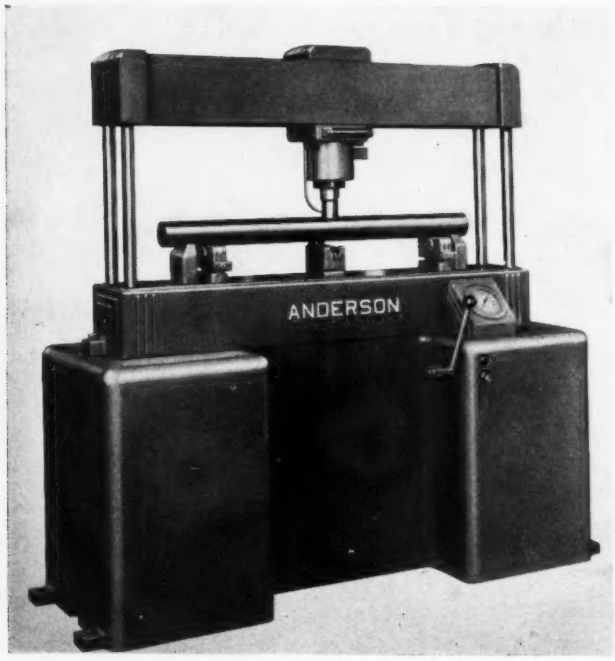
SIDNEY

THE SIDNEY MACHINE TOOL COMPANY (OHIO)

The SIDNEY MACHINE TOOL Company

Builders of Precision Machinery

SIDNEY ESTABLISHED 1904 OHIO



Traveling Ram Hydraulic Press Placed on the Market by Anderson Bros. Mfg. Co.

Hammond Carbide Tool Grinder Equipped to Produce Chip-breaker Grooves

Anderson Hydraulic Power Press with Traveling Ram

A new hydraulic power press with a traveling ram has been added to the line of presses made by Anderson Bros. Mfg. Co., 1907 Kishwaukee St., Rockford, Ill. This press, known as the Model HP-0167-P, is especially adapted for straightening camshafts. Instead of moving the anvils, centers, and work in performing straightening operations, the ram is moved along the base on ball bearings.

The base and hydraulic unit are the same as those used on the Model HP-010-P press. The sensitive control permits a shaft to be bent and inched along a thousandth inch at a time. The unit has a capacity of 10 tons. 59

Solderless Electrical Connections

A new method of solderless wiring, employing simple devices that even unskilled workers can quickly learn to use in making terminal connections, has been developed by Aircraft-Marine Products, Inc., Harrisburg, Pa., and is already being used extensively. Instead of using the conventional soldering iron, solder, and flux, the worker requires only a hand tool, resembling a pair of pliers. With this tool, he can make a wide variety of terminal connections. Pressure on the handles of the tool serves to crimp the terminal connections in such a way that a perfect connection results without the necessity of applying heat. For quantity production operation, press dies can be used in place of the hand tools. Terminal connections made by this method are said to have shown uniformly excellent results from the standpoint of tensile strength, voltage loss, and resistance to corrosion.

Another development of this concern is a simple but ingenious terminal connection for electrical wiring which has its insulation bonded to the terminal, thus eliminating the need for insulation sleeving. This invention eliminates several tedious steps in making insulated electrical terminal connections, and is claimed to be capable of making very important savings throughout the electrical field. With this new development, the work of fitting and adjusting separate pieces of insulation sleeving over terminal connections is no longer necessary. A saving in material is also effected, since insulation sleeving in various sizes is not necessary. The insulated terminal was developed from the method of solderless wiring described in the preceding paragraph, and incorporates that method in its application to the new terminal design. 60

Hammond Carbide Tool Grinder

A Model CB-76 grinder, designed for the accurate grinding of chip-breaker grooves and for the precision finishing of all types of single-point carbide-tipped tools requiring smooth sharp cutting edges, has been brought out by Hammond Machinery Builders, Inc., 1619 Douglas Ave., Kalamazoo 54, Mich. This grinder will handle all types of box and single-point tools. The tool-holding vise has universal adjustments and dials of the direct reading type for use in grinding surfaces to the required angles.

A diamond finish-grinding cup-wheel, either 6 or 7 inches in diameter, can be used. The tilting table assembly can be moved toward or away from the wheel by means of an adjusting screw. A new safety disk prevents the operator's fingers from being caught in the cup-wheel. The grinder is driven by a 1/2-H.P. motor. It has a coolant tank of 1 1/2 gallons capacity, and weighs 750 pounds. 61

"Rotab" Faceplate Built in Two New Sizes

The "Rotab," designed for holding work at any angular position for milling, boring, or other machining operations, as described in

To obtain additional information on equipment described on this page, see lower part of page 192.

8 HOURS "OVERTIME" FOR TOOLS *Free!*

SUNOCO
EMULSIFYING CUTTING OIL

PERMITS 20% LONGER TOOL LIFE . . . CHECKS RUST

Plus production will win the war . . . the kind of plus production made possible by cutting tools staying on the job longer than usual, as they did in this plant when a change was made in cutting oil.

Extra output was being retarded because of frequent tool changes . . . rusting of machined parts . . . and a tendency of the oil toward rancidity. A Sun Cutting Oil Engineer studied the conditions and recommended a change to Sunoco Emulsifying Cutting Oil.

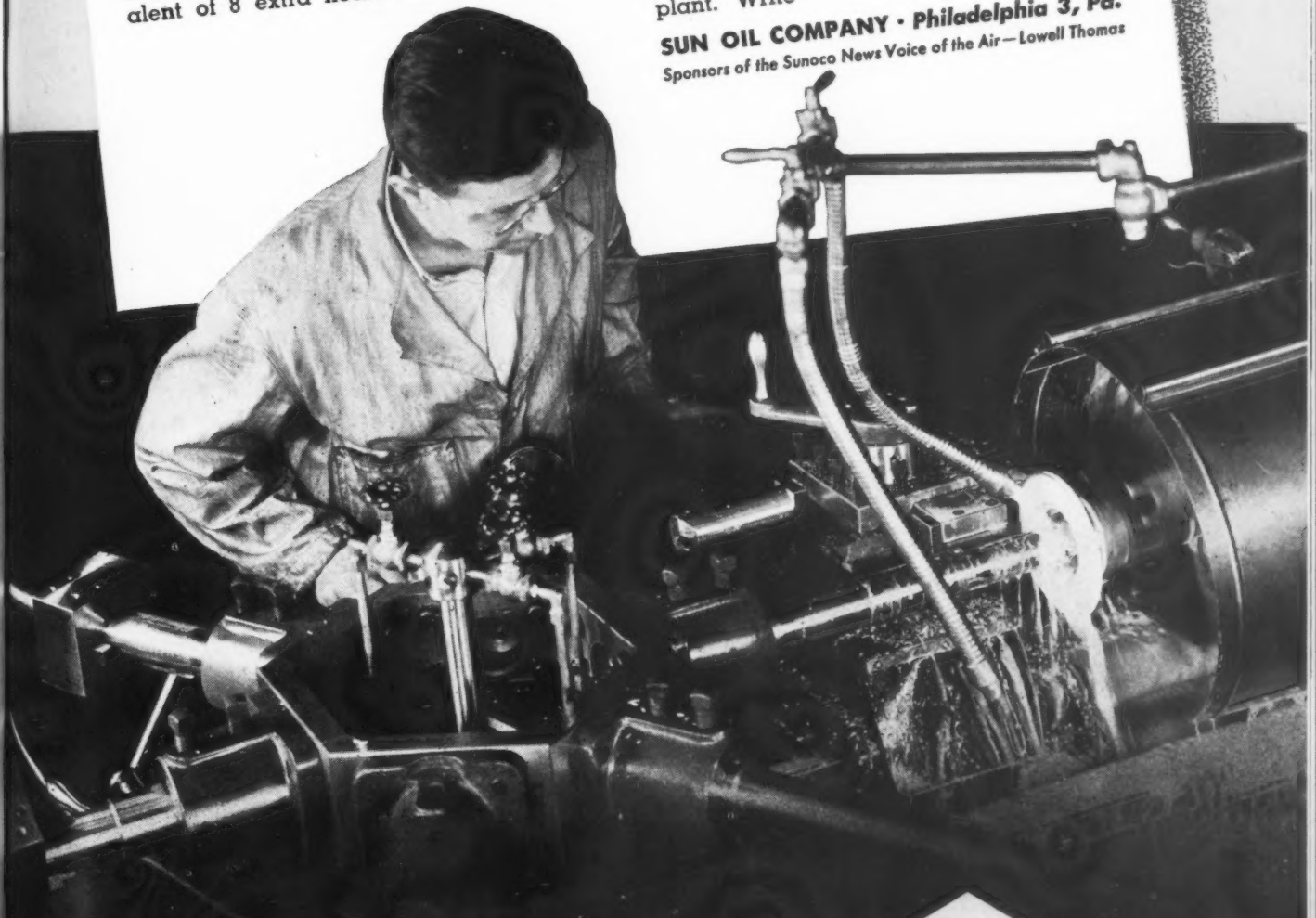
Tool life increased up to 20% — the equivalent of 8 extra hours in every 40-hour week — when they switched to Sunoco. Sunoco also proved to be an effective rust inhibitor, solving their rusting problem . . . and showed no tendency toward rancidity.

Production increased per machine tool unit in this plant . . . and in thousands of other plants where Sunoco has been put on the job. Its high heat-absorbing and rust-preventing characteristics, plus outstanding stability, make possible longer tool life . . . increased production . . . smoother finishes . . . closer tolerances.

Call a Sun Cutting Oil Engineer to show you the advantages of Sunoco Emulsifying Cutting Oil as applied to your own plant. Write

SUN OIL COMPANY · Philadelphia 3, Pa.

Sponsors of the Sunoco News Voice of the Air—Lowell Thomas



SUNOCO

SUN INDUSTRIAL PRODUCTS *HELPING INDUSTRY HELP AMERICA*

August, 1943, MACHINERY, page 214, is now being made in two new sizes by the Machine Products Corporation, 6771 E. McNichols Road, Detroit, Mich. These new machines —12-inch and 24-inch size Rotabs— have been developed to broaden the scope of applications of this work-positioning device.

The compact design of the 12-inch model makes it particularly adapted for milling operations. Like the 36-inch original Rotab previously placed on the market, the smaller model has a rotating table, to which the work is clamped and which can be turned to any angular position. The weight of the small size model is 125 pounds. The 24-inch model, which weighs 688 pounds, can be adapted to a wide range of milling and boring operations. Both models have dials with degree and minute graduations that indicate the angular setting. A sine bar is also furnished for use when very accurate angular settings are necessary.....62

DoAll Gage-Blocks

A set of thirty-seven DoAll gage-blocks is being introduced to the trade in two grades by Continental Machines, Inc., 1301 S. Washington Ave., Minneapolis 4, Minn. These gage-blocks are furnished in a newly designed pocket-carrying case 7 1/2 by 4 by 2 inches, which holds the blocks on end to facilitate handling and identification.

The set includes two 0.050-inch "wear" blocks, in addition to the five standard series of gage-blocks regularly supplied. The complete set of blocks, when wrung together, gives an over-all measurement of 11.7995 inches; thus, the set provides for any measurement from 0.050 to 11.7995 in increments of 0.0001 inch.

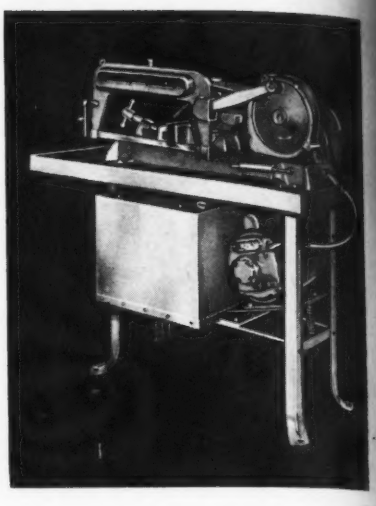
Set A, designated "Inspection Quality," is guaranteed accurate in height, flatness, and parallelism within plus or minus 0.000004 inch at 68 degrees F. Set B, known as "Working Quality," is guaranteed accurate in height, flatness, and parallelism within plus or minus 0.000008 inch at 68 degrees F.

Each of the blocks is heat-treated, seasoned, and processed to remove internal stresses and prevent warpage, growth, or shrinkage, and has a hardness of 65 Rockwell C. The dimensional size and serial number are clearly etched on each block. 63

"Excel" Power Hacksaw

The Covel Mfg. Co., Benton Harbor, Mich., is placing on the market a power hacksaw known as the "Excel," which is made in both floor and bench models, and for either wet or dry sawing. This hacksaw was designed primarily for use in departments remote from the main sawing room, as an auxiliary unit, or for regular use in small shops. It will cut off bar stock of any size up to 4 inches square. A quick-action vise holds the work securely in place, and can be adjusted for cutting at any angle up to 45 degrees.

Soft materials, such as aluminum, Bakelite, fiber, cast iron, etc., can be cut at the rate of 80 strokes per minute; medium-hard



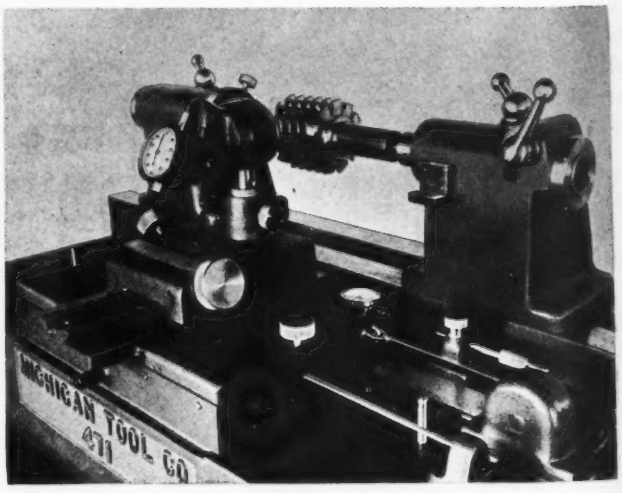
Power Hacksaw Placed on the Market by Covel Mfg. Co.

materials, such as annealed tool steel or alloy and machine steels, are cut at the rate of 60 strokes per minute; while harder materials, like spring steel, are cut at the rate of 40 strokes per minute. The floor model requires a space of 14 3/4 by 31 inches, while the bench model takes a somewhat smaller space. 64

Machine for Checking Hobs and Milling Cutters

A machine designed to completely check the accuracy with which hobs or milling cutters are reground, known as Model 471, has been added to the "Sine-Line" gear and gear-cutting tool checking equipment made by the Michigan Tool Co., 7171 E. McNichols Road,

DoAll Precision Gage-blocks



Hob and Milling Cutter Checking Machine

To obtain additional information on equipment described on this page, see lower part of page 192.

A 35-SECOND RECIPE FOR CLUTCH PLATES

Any housewife, just enlisted in war work, can understand this!

Take the rough casting for an 8" clutch pressure plate and place in the chuck of a Gisholt Hydraulic Automatic Lathe. Start machine and let run at 400 r.p.m. with .005" feed for 35 seconds or until machine automatically stops. Remove finished plate which is ready to serve on a jeep.

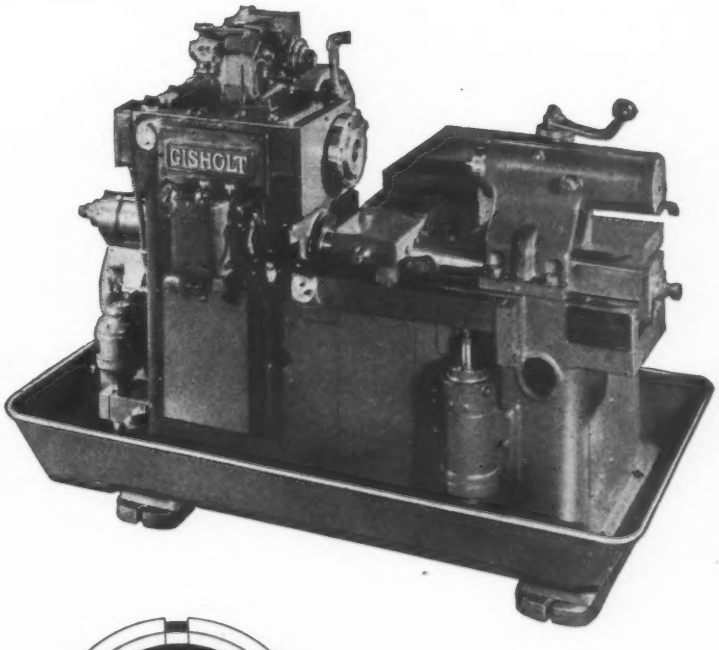
It's as simple as that with the Gisholt Hydraulic Automatic Lathe. And it's typical of the way many inexperienced workers are producing a wide variety of parts quickly and accurately to meet the demands of war production.

Gisholt engineers are ready to help you apply the speed and simplicity of the No. 12 Hydraulic Automatic Lathes to your own specific problems in large volume machining. Write for complete information.

GISHOLT MACHINE COMPANY

1209 E. Washington Ave. • Madison 3, Wisconsin

Look Ahead—Keep Ahead—With
Gisholt Improvements in Metal Turning



GISHOLT

THE GISHOLT HYDRAULIC AUTOMATIC LATHE *is adaptable to a wide variety of between-centers and chucking work. It provides high speed multiple cutting with extreme accuracy. One operator usually tends two or three machines.*

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES • SPECIAL MACHINES

Detroit 12, Mich. Hobs or milling cutters with a maximum outside diameter of 10 inches, a maximum length of 8 inches, and an arbor or shaft length of 16 inches can be checked for spacing of flutes on either parallel or spiral gash types, rake angle of flutes, parallelism of straight flutes, taper on outside diameter, and concentricity of diameters by means of two standard interchangeable indicator assemblies.

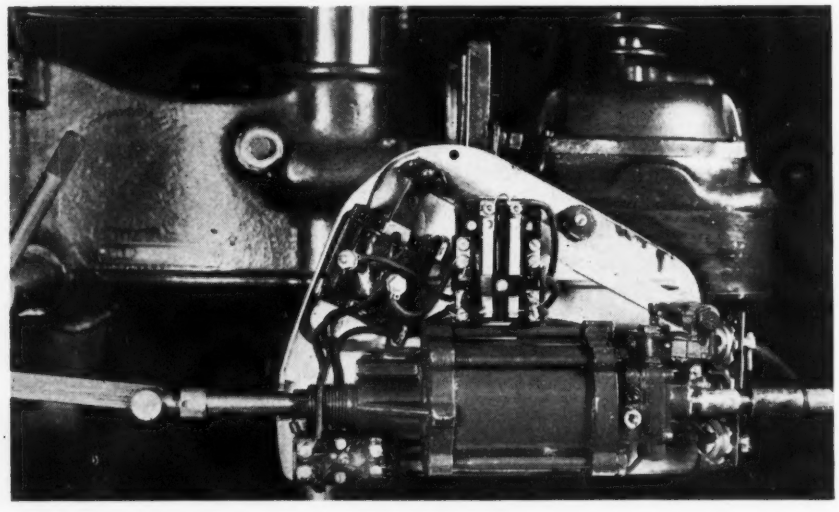
Two additional interchangeable indicator assemblies are available for checking the lead of the hob or spacing of threads in multiple-thread hobs, as measured in a plane parallel to the axis of the hob, and for checking tooth depths.....65

Electrically Controlled Air Power Feed for Converting Drill Press into Automatic Tapper

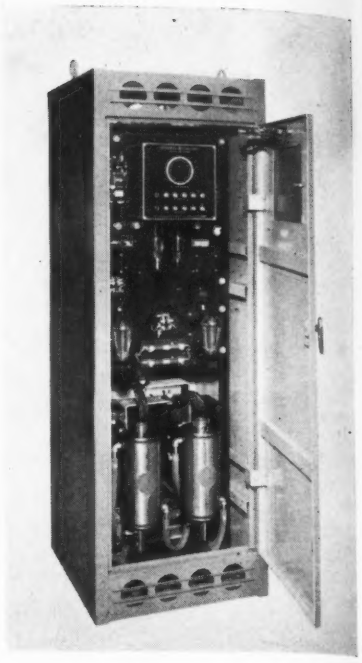
Automatic tapping of Class 3 fit threads is said to be possible on almost any type of drill press when using precision ground taps and the "Electroaire" power feed unit brought out by the Bellows Co., Akron, Ohio. This new power feed utilizes a solenoid-controlled Bellows air motor to advance and retract the spindle. Feed and retraction speeds are independently controlled, and are subject to infinite variation. The down feed is held under exact sensitive pressure to prevent thread forcing. The same precise control of the reverse feed permits the tap to practically "float" out of the work, thus eliminating strain on the tap.

Operation of the feed is controlled by a foot-switch, which leaves both the operator's hands free to insert and remove the work. The feed can be synchronized with solenoid-controlled jigs, work feeds, and fixtures to obtain complete automatic operation. The power feed can be set for multi-cycle operation with indexing fixtures.

The new feed also makes possible high-speed automatic drilling with wire size drills. Burning of drill tips and drill breakage are reduced by automatically slowing up the rate of feed at the break-through point. Precise depth control permits drilling or tapping blind holes to close tolerances. The stroke is adjustable up to a maximum of 1 1/4 inches. 66



Bellows Electrically Controlled Air Power Feed Applied to Drill Press for Automatic Tapping



General Electric Electronic Timing Control for Seam Welding

General Electric Seam Welding Control

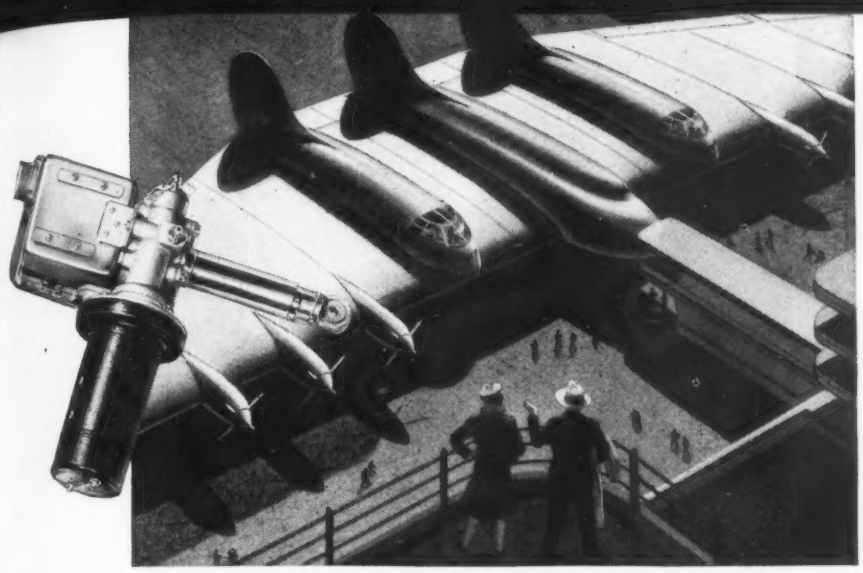
A control with electronic timing circuit, designed exclusively for seam welding, has been announced by the Industrial Control Division of the General Electric Co., Schenectady, N. Y. This new resistance welding control, designated Type CR7503-B110, is especially suitable for operations where frequent changes of the timing pattern are required, as in welding a variety of materials of different shapes and thicknesses. It operates on 230-, 460-, 550-, or 575-volt, single-phase, sixty-cycle power supply, and consists of a timing panel, a firing and a heat-control panel, and a power panel, any one of which can be separately disconnected and removed to facilitate inspection or servicing.

The complete control is mounted in a floor type enclosure, the full-length front and rear doors of which can be locked. The calibrated heat-control dial is accessible through an opening in the front door. Snap switches that provide instantaneous and independent adjustment of the "heat" and "cool" time in one-cycle steps from one to thirty cycles are also located on the control-dial panel. The water supply inlet and outlet fittings are on the outside of the enclosure, and a row of indicating lights on the front door show instantly whether the water flow is adequate, the power has been applied, and the time delay has functioned.....67

"Master" Collet Chucks

A new line of "Master" collet chucks of larger capacity than any previously made has recently been placed on the market by United Industries, 8344 Second Boulevard, Detroit 2, Mich. The new line includes four standard sizes, with capacities for holding round bars

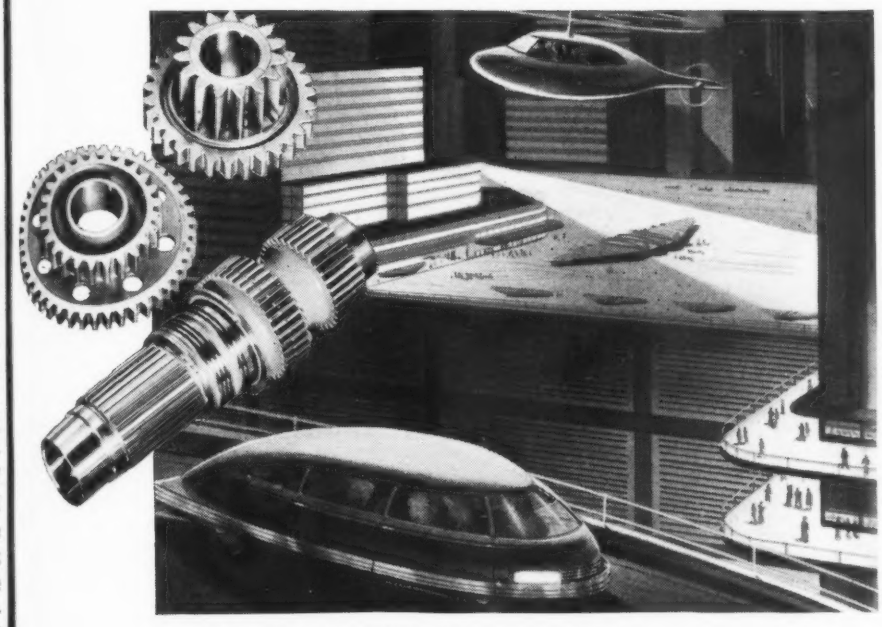
To obtain additional information on equipment described on this page, see lower part of page 192.



These compact, efficient packages of power will perform many of the jobs in controlling the flight of tomorrow's skyliners. Their high precision has won them a place in today's fighter planes.

PROMISE OF A BRIGHT FUTURE

in the Transmission of Power...



Mass production of high precision gears will assure more efficient performance — greater compactness and increased speed in tomorrow's machines.

THE demands of war have brought a revolution in the economical transmission of power. Here at Foote Bros. new advances in engineering—new developments in the manufacture of extremely high precision gears, speed reducers and aircraft devices, give promise to American manufacturers of a new era of "better power transmission through better gears" when the war is won.

Tomorrow these new developments may solve problems for you in the equipment you manufacture. When that time comes, you may look to Foote Bros. for gears and speed reducers in any size—held to the tolerances you require. Foote Bros. will also be able to offer you an engineering service to assist your designers in any power transmission problem requiring the use of gears and speed reducers.

Improved speed reducer designs assure greater compactness—smoother operation and a new efficiency to tomorrow's equipment manufacturers.

FOOTE BROS. GEAR AND MACHINE CORPORATION
5225 South Western Boulevard, Chicago 9, Ill.

FOOTE BROS.

Better Power Transmission Through Better Gears

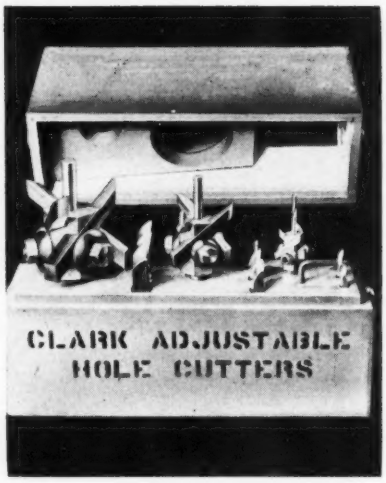
3/4, 1, 1 3/4, and 2 3/4 inches in diameter. Larger sizes can be had.

The collets provide a powerful grip to eliminate any possibility of stock slippage. The hand-lever can be used to operate the collet without stopping rotation. 68

Haynes Stellite-Tipped Tools

Two new styles of Stellite-tipped tools especially designed for machining steel have been announced to the trade by the Haynes Stellite Co., Unit of Union Carbide and Carbon Corporation, Kokomo, Ind. The new tools, designated Styles P and Q, consist of a cutting tip of Stellite 98M2 cobalt-base alloy, brazed or butt-welded to a tough steel shank, with the proper clearance and lead angles ground for turning steel. These and other Stellite-tipped tools are recommended for work requiring cutters that have a large cross-section or that are bent or offset. In addition to their application to turning, boring, and facing operations, these tipped tools are also adapted for various types of forming.

Style P is a right-hand tool, and Style Q a left-hand type. They are ground with a 15-degree end cutting-edge angle, a 15-degree side cutting-edge angle, a 7-degree end relief angle, and a 7-degree side relief angle. These tools are furnished with flat tops, so that users can grind their own side rake angle for each particular job. Five sizes of each tool are stocked, ranging from 5/8 to 1 1/4 by 8 inches up to 1 1/4 by 1 1/4 by 7 inches. Styles P and Q are also made with Stellite Star J-Metal tips.....69



Adjustable Hole-cutters Made by Robert H. Clark Co.

Clark Adjustable Hole-Cutters

A set of three adjustable hole-cutters that can be set to cover a range of diameters from 5/8 inch to 3 1/2 inches has just been brought out by the Robert H. Clark Co., 9330 Santa Monica Blvd., Beverly Hills, Calif. These cutters are made with straight shanks to be used either as hand tools or in portable electric and pneumatic drills or light drill presses for producing accurate, clean holes in both thick and thin metals. They can also be used in lathes and other spindle type machines.

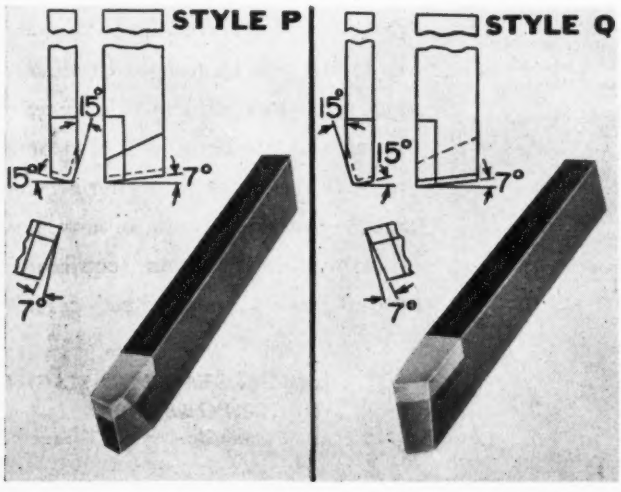
The cutters consist of a straight shank on a hexagonal body into which are set three high-speed steel blades spaced at angles of 120 degrees. The three hole-cutters, with an extra set of blades for each, are packed in a wooden box 3 1/2 by 7 1/4 by 10 inches in size, as shown in the illustration. 70

Wilson Coated Aluminum-Bronze Electrode

The Wilson Welder & Metals Co., 60 E. 42nd St., New York 17, N. Y., has announced to the trade a new coated aluminum-bronze electrode designated No. 200. This high tensile strength bronze electrode of the shielded arc type can also be used as a filler rod in carbon arc welding. It is designed to produce strong, ductile welding deposits that resist corrosion. The new electrode is applicable in the welding of most bronzes, malleable iron, cast iron, and steel. It is especially adapted for welding manganese bronze and for welding dissimilar metals, such as cast iron to brass, steel to malleable iron, etc. Any two metals that are weldable with aluminum bronze can also be joined. The electrode is available in 1/8- to 3/16-inch sizes, 14 inches long, and in 1/4-inch size, 18 inches long. Sizes from 5/16 to 1/2 inch in 18-inch lengths can be furnished on special order.....71

Plastic Safety Goggles for Industrial Workers

Two new "AO Ful-Vue" plastic safety goggles, made extremely light in weight without sacrificing strength, have been brought out by the American Optical Co., Southbridge, Mass. These goggles—one with side shields and the other



Haynes Stellite-tipped Tools for Machining Steel

Plastic Safety Goggles Made by American Optical Co.

To obtain additional information on equipment described on this page, see lower part of page 192.

BLONDE? MAYBE--SMART? COULD BE!

MUSCLE? NOT MUCH→→→→→→BUT, BROTHER, SHE'LL DO A WHALE OF A JOB ON YOUR ASSEMBLY LINE

IF YOU USE THE RECESSED

HEAD SCREW THAT MAKES SCREW DRIVING TROUBLE-PROOF

--THAT ENDS THE NEED FOR SKILL AND

BRAWN

←←←←←←IT'S PHILLIPS

Anyone can drive Phillips Screws!

Time was when it took real "he-men" to drive screws. They had to be strong . . . had to have skilled hands . . . had to be trained. But today the job's a cinch for anyone!

What makes it a cinch is the Phillips Recessed Head Screw – the screw which, time studies prove, steps up screw driving speed as much as 50 per cent.

With Phillips Recessed Head Screws, there's no premium on brawn! They drive easy – because turning power is fully utilized. Nor is there any premium on training or skill. Dangerous driver skids are out, and workers just can't fumble, make wobbly starts, or drive slantwise.

As a result, untrained girls quickly match anything experienced male operators do – driving Phillips Screws.

Think what this means to you in (1) man-and-training hours saved, in (2) increased production, in (3) finer workmanship. Then ask yourself if you're getting the same advantages from slotted head screws . . . or from any other type you're using.

PHILLIPS *Recessed Head* SCREWS

WOOD SCREWS · MACHINE SCREWS · SELF-TAPPING SCREWS · STOVE BOLTS

TO MAKE WARTIME QUOTAS AND PEACETIME PROFITS

Faster Starting: Driver point automatically centers in the Phillips Recess . . . fits snugly. Fumbling, wobbly starts, slant driving are eliminated. Work is made trouble-proof for green hands.

Faster Driving: Spiral and power driving are made practical. Driver won't slip from recess to spoil material or injure worker. (Average time saving is 50%.)

Easier Driving: Turning power is fully utilized. Workers maintain speed without tiring.

Better Fastening: Screws are set-up uniformly tight, without burring or breaking of screw heads. The job is stronger, and the ornamental recess adds to appearance.

IDENTIFY IT!

Center corners of Phillips Recess are rounded . . . NOT square.

Bottom of Phillips Recess is nearly flat . . . NOT tapered to a sharp point.

23 SOURCES

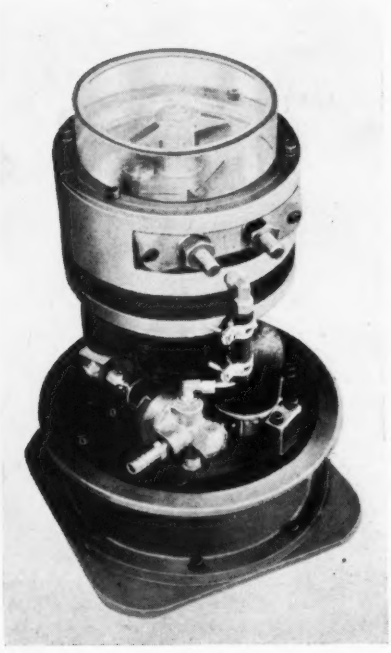
American Screw Co., Providence, R. I.
Atlantic Screw Works, Hartford, Conn.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
General Screw Mfg. Co., Chicago, Ill.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
Manufacturers Screw Products, Chicago, Ill.
Milford Rivet and Machine Co., Milford, Conn.
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.

plain—are particularly suited for the "metal-allergic" worker, whose skin is sensitive to metal goggle frames, and for the worker engaged in operations where there is likelihood of fire or explosion. The goggles are available in pink, crystal, or green color plastic frames, with six-curve Super Armorplate lenses. 72

Current Interrupter for Stored-Energy Welders

Sciaky Bros., 4915 W. 67th St., Chicago 38, Ill., have brought out a new device, known as a "Dynatrol," for high-speed arcless current interruption of inductive direct-current welder circuits. The Dynatrol is designed to replace the magnetic contactors formerly used on resistance welders of the electromagnetic stored-energy type, and is available for use on all Sciaky stored-energy welders up to and including the 50-kilowatt size. It is claimed to increase the operating speed 20 per cent.

The new device is essentially a high-speed single-pole interrupter, the contact points of which are shunted by a bank of capacitors. The rapidly accelerated opening movement of the contact points serves to prevent a discharge while the primary current is directed to the capacitors. 73



"Dynatrol" for High-speed Arcless Current Interruption

Aero Countersink with Micrometer Stop

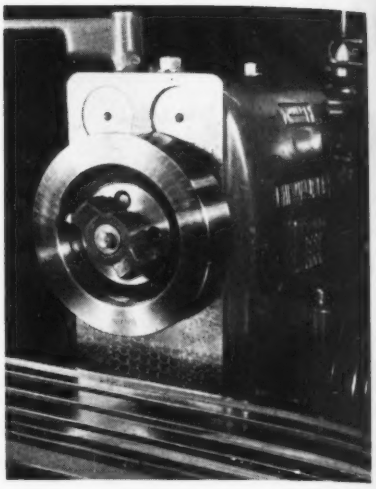
A large countersink provided with a micrometer stop, designed for the precision countersinking of holes for large rivets, bolts, and screws, has been developed by the Aero Tool Co., Burbank, Calif. This new tool countersinks up to 1 1/4 inches, and is capable of countersinking for the heads of 1/2-inch rivets. The micrometer stop is adjustable in increments of 0.001 inch, and can be instantly and positively locked at each setting. Adjustment can be made while the tool is in operation.

Countersink with Micrometer Stop Made by Aero Tool Co.

The standard countersink includes a precision-ground interchangeable 1-inch diameter cutter of heat-treated high-speed steel which is available for countersinking to angles of 72, 78, 82, 100, 110 and 115 degrees, with or without an integral pilot. The radial bearings are bronze, and the thrust bearing is of the ball type. The stop is spring-loaded for positive action and safe operation. 74

Weddell Flywheel Arbors and Adapters

Weddell Tools, Inc., 1239 University Ave., Rochester 7, N. Y., have developed simple flywheel arbors or adapters that are designed to dampen the vibration caused by the intermittent cutting action of coarse-bladed milling cutters. The



Weddell Flywheel Arbor Designed to Dampen Vibration when Taking Intermittent Milling Cuts

potential energy stored in the heavy rim of the wheel between cuts increases considerably the force available for cutting.

The standard shell end-mill arbor is replaced by the flywheel arbor, which can be readily mounted on the machine spindle. The combination arbor and flywheel has a nose which is identical with that of the end of the shell end-mill arbor on which the fly cutter is mounted. The flywheel arbor is made with counterbored back or locating means to fit any milling machine or horizontal boring mill. The arbor nose is made in standard sizes from 3/4 to 2 1/2 inches in diameter.

For cutters that fit directly on the spindle, a flywheel spindle nose adapter is available. In this case, the back is counterbored or adapted to fit the machine spindle nose, while the front is the same as the machine spindle nose, thus permitting mounting of the standard cutter. Similar adapters are available to accommodate taper-shank cutters. 75

Equipment for Removing Sludge from Sump Tanks

What is known as a "sump vacuum producer," mounted on a closed tank on wheels, for removing all the liquid and sludge from sump tanks of machine tools has been placed on the market by the Spencer Turbine Co., Hartford 6, Conn. With this equipment, it is possible to empty sump tanks in from two to ten minutes, compared

To obtain additional information on equipment described on this page, see lower part of page 192.

LAKE ERIE

Keeps Pace with Engineering Progress

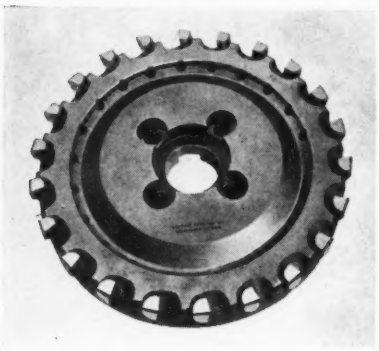
OFFICIAL U. S. NAVY PHOTO

***LAKE ERIE** Hydraulic Presses are being used to turn out over eighty per cent of our aircraft, and are also shaping America's fighting equipment in all fields of action, ably withstanding the strain of constant war use.*

LAKE ERIE ENGINEERING CORPORATION • BUFFALO 17, NEW YORK

with half an hour, the time usually required. Forty gallons of liquid can be removed per minute.

The tank has a capacity of 125 gallons, which is enough for from three to five average machines. It is emptied by gravity in a couple of minutes and can also be emptied by turning a valve and connecting a hose to the drain valve. In that way, the liquid can be discharged under approximately 3 pounds of pressure. This permits raising the liquid to a height of about 6 feet, so that the tank can be emptied into a drum for easy disposal.....76



Inserted-blade Milling Cutter Made by Lovejoy Tool Co.

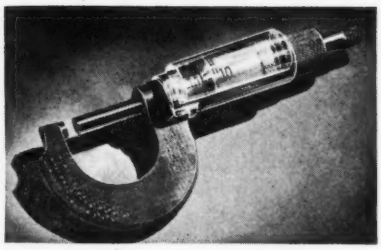
Lovejoy Inserted-Blade Milling Cutter

To meet the demands of modern milling requirements, the Lovejoy Tool Co., Inc., Springfield, Vt., has designed a new heavy-duty face milling cutter. The blades in this new Type H cutter are 1 inch in diameter, and are capable of taking cuts up to 3/4 inch. The well-known Lovejoy locking principle is employed, and the blades are interchangeable through the complete range of Type H sizes.

This new milling cutter is furnished in diameters of from 6 to 8 inches for shell-end arbor mounting, and in diameters of 9 inches and larger for spindle mounting. Many of these new cutters have been furnished with negative cutting angles. The 1-inch diameter blades are designed to provide rigid support for carbide tips.....77

"Magna-Eye" Attachment for Micrometers

A "Magna-Eye" attachment for micrometers, designed to magnify the scale so that it can be read more accurately, especially under poor lighting conditions, is a recent product of the Stebar Mechanical and Electrical Research Laboratory, 711 W. Lake St., Minneapolis 8, Minn. This device, made in light-weight transparent methyl-methacrylate, fits closely over the micrometer scale without interfering with its use. It is available for application to all standard makes of micrometers. 78



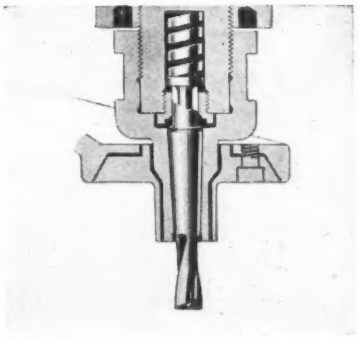
Micrometer Equipped with "Magna-Eye"

Thread Gages for High-Pressure Hydraulic Fittings

The gages here illustrated have been brought out by Vard Inc., 2961 E. Colorado Blvd., Pasadena 8, Calif., to meet Army-Navy Specifications AN-GGG-P-363, which require the use of a set of three gages for the inspection of external taper pipe threads on hydraulic fittings. This set of pipe ring gages meets all requirements for gaging this type of thread. They comply with American Gage Design Standards, and are made of selected tool steel, hardened, ground, and finished to specified tolerances.

The Vard pipe ring gages are made in three primary types—the L-1, which is a thin ring for checking lead, pitch diameter, and taper of thread at minimum thread length; the L-2, for checking thread form, pitch diameter, and taper of thread at full length of effective thread; and the plain taper ring furnished with six steps for checking the truncation on the major diameter taper threads. 79

Thread Gages for High-pressure Hydraulic Fittings Brought out by Vard, Inc.



Onsrud Taper Chuck Developed for Routing Machine

Onsrud Taper Chuck for Radial-Arm Routing Machine

The performance of radial-arm routers used for the high-speed production of non-ferrous flat sheet parts is claimed to have been greatly improved by the use of an inverted taper friction chuck recently brought out by the Onsrud Machine Works, Inc., 3940 Palmer St., Chicago 47, Ill. This chuck permits the router bits to be gripped immediately adjacent to the cutting edge, as shown in the illustration. This gripping method serves to conteract the effects of side thrust and thus holds bit breakage to a minimum.

An important part of the inverted taper chuck assembly is the spring and pin unit employed to maintain pressure on the end of the router bit. This pressure causes the tapered surfaces of the bit and chuck to be forced together so tightly that it is not possible for slippage to occur. 80

To obtain additional information on equipment described on this page, see lower part of page 192.

When you want more than prints of your drawings

Getting your drawings into print form...and to the men on the assembly line . . . is probably your first concern.

You are sure of faster results, and better prints, *when you have an Ozalid machine.*

You know, also, that you're equipped for more than "ordinary printmaking". . . and that you can save time, labor, and materials—in print production. . . in the drafting room . . . throughout your organization.

You receive "extra values" because Ozalid is different from any other reproduction process. The *big* difference being OZALID DRY DEVELOPMENT.

IF YOU'RE NOT USING OZALID

- You can add an Ozalid Dry Developer which can be used with your present printer.
- You can order an Ozalid whiteprint machine which incorporates printing and dry developing units.

There's a machine designed for your print production requirements. When it's installed—you'll have *more* than a printmaking process.

EXTRA VALUES YOU RECEIVE WITH OZALID

• Ozalid Dry Development

Eliminates water and potash baths, driers, multiple controls. All types of prints are produced in the same operation—no "stops" in production. "Skilled Help" is no longer a printmaking requirement.

• Complete Line of Sensitized Materials

Papers, cloth, and foils can be processed—an impossibility with other methods. These are available in cut sheets as well as roll stock—thus you can eliminate trimming waste.

You can make prints having black, blue, or maroon lines on a white background. You can assign identifying colors to prints of different departments, distinguish checked from unchecked prints, etc.

• Ozalid Transparent Duplicates

May be substituted for valuable originals in subsequent print production . . . or employed by draftsmen to eliminate retracing when making design changes.

• Ozalid Foils

May be used to reclaim soiled or worn originals, to make composite prints...or fast printing "duplicate" originals.

• New Ozalid Rapid Black

Hailed by reproduction men as the finest dry developing paper ever made. Recommended for reproducing pencil drawings, typed material, and for printing from photographic positives.

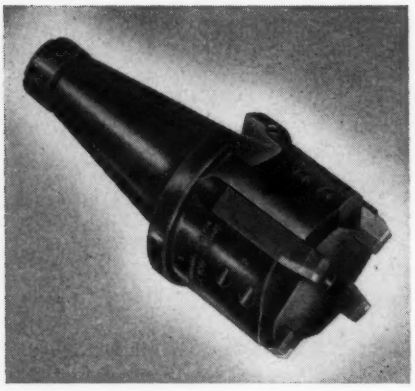
For complete information, write for Catalog and samples of Ozalid Whiteprints.

OZALID PRODUCTS DIVISION

GENERAL ANILINE & FILM CORPORATION

Johnson City, New York

OZALID IN CANADA—HUGHES OWENS CO., LTD., MONTREAL



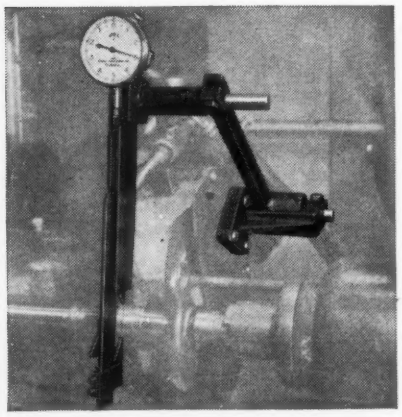
Kennamill Inserted-blade Cutter

Kennametal Inserted-Blade Cutters

Kennametal Inc., 147 Lloyd Ave., Latrobe, Pa., has brought out a line of inserted-blade cutters known as "Kennamills" for step-milling steel. These new cutters are available in four sizes—2-inch with three blades, and 3-, 4- and 5-inch with four blades. The 2- and 3-inch sizes have taper shanks to fit Nos. 40 and 50 spindles, while the 4- and 5-inch sizes have taper shanks to fit the No. 50 spindle only. All sizes use the same standard replaceable Kennametal-tipped blades No. 39M40. Two sets of blades are supplied with each cutter-head.....81

Stuart Micromatic Visual Grinding Gage

Clawson & Bals, Inc., 4701 W. Lake St., Chicago, Ill., is placing on the market the Stuart micromatic visual grinding gage here illustrated, which can be applied to and taken off work while the machine is in operation, thus eliminating hand "miking." The dial indicator serves as a guide while the work is being ground to size. The gage is designed for use in maintaining tolerances of plus or minus 0.0001 inch, and is made in two models with ranges of 1/8 to 1 1/4 and 5/8 to 2 1/2 inches. Additional calipers for the larger model provide ranges of 2 to 5 and 5 to 8 inches. 82



Micromatic Grinding Gage for Use while Machine is in Operation

Compressed Air Unit for Operating Bench Vise

Foot control of the air pressure which actuates the VISpeed unit brought out recently by the Van Products Co., Erie Trust Bldg., Erie, Pa., converts any 4- or 4 1/2-inch vise into a fast operating work-holding device that leaves the hands of the operator free to handle the work or manipulate the tools. Toe pressure on the pedal causes the vise jaws to close, while heel pressure serves to open them.

Bench Vise Equipped with Foot-controlled VISpeed Rapid Opening and Closing Device

Any pressure from 0 to 2 1/2 tons is instantly available at the vise jaws for holding the work. Delicate parts or soft materials can be held without damage or marring. Once the required jaw opening is selected, the piston stroke can be adjusted from 0 to 1 inch to speed up the opening and closing of the vise. The unit is easily attached to the vise body, and does not interfere in any way with hand operation of the vise.....83

A Youth Organization with a Purpose

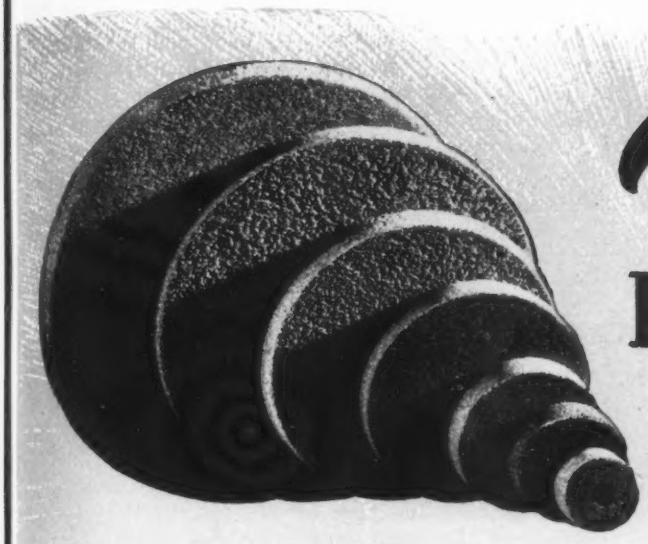
Learning by doing is the keynote of the Junior Achievement program. This unique organization, whose significance is becoming more and more appreciated by national, educational and business leaders, endeavors to meet the needs of young men and women for practical training and experience and to help them take their place in the industrial and business life of America.

Briefly, the program is as follows: Groups of boys and girls from fourteen to twenty-one years old organize themselves in small "companies" which are managed and operated by the young people themselves. These companies raise their own capital by selling stock at 50 cents a share, for the purpose of producing a product or performing a service. They maintain a factory—usually vacant space in a loft building—and meet the expenses for rent, light, heat, and wages to the workers within their own group. These organizations of young people finance themselves, manage themselves, make a product, or render a service, and sell that product or service through their own efforts.

In this way, these boys and girls are given an understanding of how business and industry function, how markets have to be sought and maintained, and the relationship between cost and selling price. They also come to realize the important part played in our national well-being by individual enterprise, and they soon recognize that some of their fellow workers have greater managerial ability than others, some are better salesmen than others, and some have greater mechanical ingenuity and capacity for manual skill than others. These boys and girls find their own place in their organization in just the same way as men and women find their place in the business and industries of the country.

These Junior Achievement companies have been organized in a great many cities and towns throughout the country. Local committees of business men give guidance and advice. Some of the men who are now acting as advisors occupy leading positions in the industrial world. Eric A. Johnston, president of the United States

To obtain additional information on equipment described on this page, see lower part of page 192.



Prelude TO A PERFECT FINISH

CHICAGO MOUNTED WHEELS AND SMALL GRINDING WHEELS

A complete range of styles, grains and sizes up to 3" in diameter to give you a perfect finish on every job.

PROMPT DELIVERY

Specialization—with full W P B approval—on sizes 3" in diameter and under, means no waiting for Chicago Grinding or Mounted Wheels. Let us take care of your present and post-war requirements.

FREE *ENGINEERING ANALYSIS*

If you have a grinding job that presents a problem because of the nature of material, tricky shape or other reason, tell us about it. Our experts will go into a huddle and give you the benefit of our long experience making millions of custom built wheels for every conceivable operation.

YES, YOU CAN FINISH IT BETTER WITH A CHICAGO WHEEL

Half a Century of Specialization has Established our Reputation as the Small Wheel People of the Abrasive Industry.

Army-Navy

MOUNTED WHEELS

SMALL GRINDING WHEELS

Just as the prelude to a new world is better tools of war, so the prelude to a perfect finish is better grinding wheels.

Today's standards of finishes are far and beyond those of yesterday. To acquire them without sacrifice of production time is a goal which everyone seeks.

Finish must now be measured in micro inches. That's where the new Chicago FV BOND Wheels excel. They give a precision smoothness so intensified that it passes any surface analyzer test, in many cases eliminating hand lapping and auxiliary finishing operations.

HERE'S WHAT MAKES CHICAGO WHEELS CLICK—

A—Sensational new FV BOND. Result of research and experiment on hundreds of aircraft jobs.

B—No sacrifice of cutting time or wheel life.

FV BOND is available in all types of Chicago Mounted and Small Grinding Wheels—in all abrasives, grain and grade combinations.

TEST WHEEL FREE — To prove their superiority in your own shop, send for a Chicago Wheel made with FV BOND. Give us details of the job, material you want to finish and we'll do the rest.

Write for Catalog and interesting Engineering Survey Form

CHICAGO WHEEL & MFG. CO.

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Send Catalog and Survey Form. Interested in
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Size _____

NAME _____ MR-5

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Chamber of Commerce, says: "There is no other organization that I know of that so definitely fills the need for the training of our youth in the American way—the way of individual initiative and enterprise."

Men engaged in business and industry who wish to aid the young people in their own locality with advice and guidance along these lines can obtain further information with regard to the organization by addressing Junior Achievement, Inc., 16 E. 48th St., New York 17, N. Y.

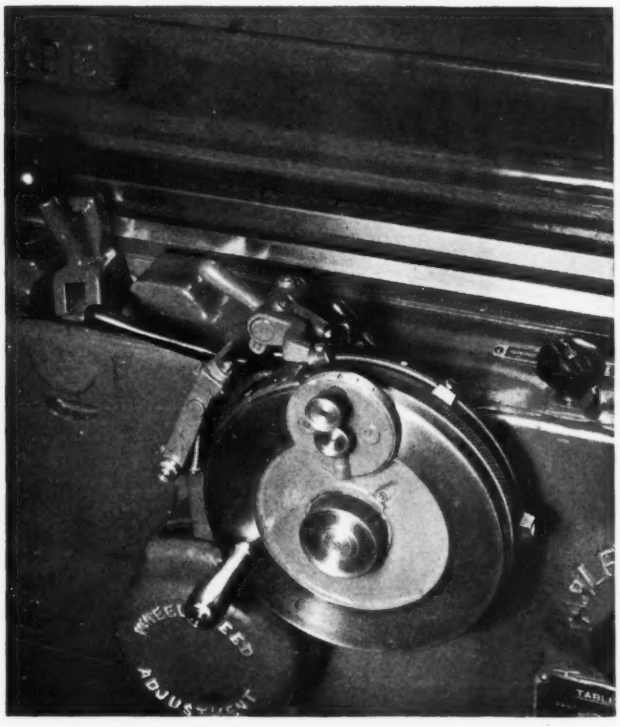
Step-Grinding Cylindrical Work is Simplified by Using Multiple Stops

Many shafts or spindles finished on cylindrical grinding machines require the grinding of several cylindrical surfaces to successively smaller diameters without removing the work from the machine centers. This procedure is necessary in order to maintain the extremely close limits of accuracy required with respect to concentricity. Ordinarily, each diameter must be measured individually as the grinding progresses. These measurements necessarily consume a considerable amount of time, especially on large-lot production.

In order to speed up step-grinding operations in a certain plant, the Brown & Sharpe Mfg. Co., Providence, R. I., recently fitted its No. 23 plain grinding machine with multiple stops on the cross-feed handwheel, as shown in the accompanying illustration. The stops are carried on a disk mounted behind the regular handwheel, which can be unclamped from the cross-feed screw for making adjustments to compensate for wheel wear. The stops or dogs are numbered, so that the operator can see at a glance to which diameter each applies.

As each diameter on the first piece is ground to size, a stop is set in contact with the positive stop on the machine. Upon completion of the grinding of one step on subsequent pieces, the pivoted dog-stop on the machine bed is raised, the handwheel is used to run the wheel back to clear the next diameter, and the table is positioned longitudinally. Rotating the handwheel dial, which, in turn, rotates the handwheel, brings the edge of the blank section of the toothed periphery opposite the face of the dog numbered to correspond with the desired diameter. The wheel is then brought forward to "spark" the piece, the pivoted dog-stop lowered, and the automatic cross-feed started. The wheel now feeds in automatically until the dog is almost in contact with the pivoted stop. Hand feed is then used to complete the grinding, the work being brought to the finished size when the stops are brought together.

When the grinding wheel requires dressing, the clamp that holds the dog-carrying disk to the back of the handwheel is loosened, thus permitting the handwheel to be rotated for dressing without rotating the dogs. After the wheel is trued, the first diameter on the piece is ground to size, the corresponding dog is brought against the positive stop, and the dog-carrying disk clamped. With the blank section of the handwheel periphery adjusted to the proper position, the machine is again ready for production step-grinding.



Cross-feed Handwheel of Cylindrical Grinder Equipped with Stops for Step-grinding

* * *

Improved Explosive Rivet

An improved explosive rivet, permitting of greater speed in operation and increased uniformity of results, has been developed by the Explosives Department of E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del. The rivet is expanded from within, along practically its entire length, by a tiny explosive charge. This is a marked improvement over the original explosive rivet produced by the company, which is now extensively used in the aircraft industry. The original rivet, introduced two years ago, was expanded at the end only to lock it in place. This method is used in connection with rivets made from an aluminum alloy.

* * *

Synthetic Rubber Invasion Boats

According to data published by the United States Rubber Co., invasion boats built from synthetic rubber, designed to glide noiselessly in shallow water, are being produced in quantity by the United States Rubber Co. The boats, which can be inflated, are equipped with quick-release towing bridles, so that they can be towed behind fast boats and released to beach themselves by their own momentum. Each boat can carry ten men with full equipment. These boats, being collapsible, are easily transported, can be packed in compact carrying cases, and quickly inflated.

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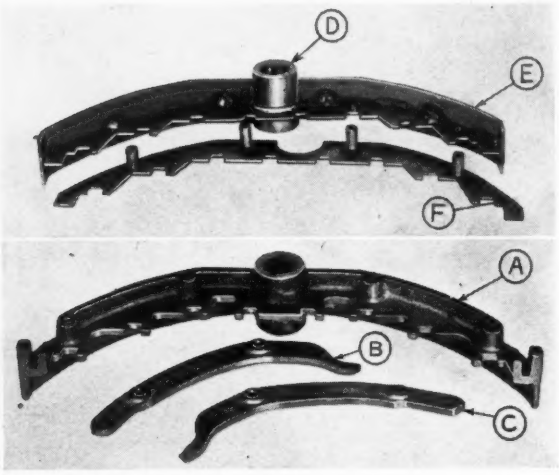
Stampings Used to Replace Castings

An interesting example of conversion from cast to stamped metal parts is shown in the accompanying illustration. At *A*, *B*, and *C* are shown the castings, and at *E* and *F* the two stampings that were designed to replace these three castings. Part *D* was made on a screw machine, while parts *E* and *F* were produced in a die designed for the purpose by the Dayton Rogers Mfg. Co., Minneapolis, Minn. Part *D*, which served as a machine bushing, was welded to the assembly, which includes part *E*. A similar part *F* was also welded to *E*. This construction represents a considerable saving and a more accurate job with respect to tolerances. By using a special alloy steel for the stampings, much greater strength was obtained in the final assembly than when castings were used.



(Upper View) Stampings Used to Replace Castings Shown in the Lower View

Although only 300 or 400 of these units were originally produced in a year, the low cost of the blanking tools made them a good investment. In fact, it was found that the blanking and piercing dies used in producing the stamped parts cost less than the pattern, drill jigs, and milling fixtures employed in producing the cast parts. When it later became necessary to increase production of the stamped pieces, the preceding development work provided a good basis for building permanent stamping tools or dies for accomplishing the job, which could not have been handled by the casting methods.

Maintenance of Production Resistance Welding Equipment

Resistance welding machines are an essential part of the production equipment in many plants, and require as careful maintenance as the ordinary types of machine tools. E. R. Spittler, of the General Electric Co.'s Works Laboratory, recommends that a regular schedule should be maintained for periodic inspections of parts of welding machines that may require replacement. A few pointers may be of value in this connection:

If the welding transformer is water-cooled, be sure that the water circulates freely at all times during the operation of the machine. Remove all dirt, dust, and grit from the transformer and secondary circuits at least once a week. An accumulation of particles from the flash may cause a short circuit in the transformer winding.

The switches, contactors, and timing devices are the nerve centers that control the operation of a welding machine. They must be kept in good condition, mechanically and electrically. They should be checked every two months for evidence of wear, for oxidation at fuse connections in the switches, for loose electron-tube sockets and loose wiring in the timing devices.

Electrodes, welding wheels, dies, or mandrels that have become burned or pitted are a constant source of trouble. By frequently refacing the working surfaces of the electrodes, poor welds can be avoided.

The accuracy of the welded assembly can only be as good as the fixtures holding it in place during the welding operation. For that reason, close inspection and frequent adjustment of the fixtures are necessary.

The motors, variable-speed drives, clutch and reduction units, and transmission gears and shafts should be inspected and adjusted, or overhauled, at frequent intervals; the frequency, however, depends upon the production load, and must be gaged by past experience.

All welding machines have some device for producing the welding pressure. Usually this consists of an air or hydraulic cylinder, or a cam or toggle with spring arrangement. This system must be inspected periodically and all air and oil filters cleaned at regular intervals. Obviously, all moving parts must be oiled and greased at regular intervals. In lubricating, care should be taken to avoid dropping oil or grease on any of the electrical wiring or connections.

* * *

Revolutionary Development in Treatment of Wood

Chemical means for converting ordinary wood into what appears to be entirely different products have been developed by E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del. Through chemical treatment, for example, doors, windows, and drawers can be constructed that will not swell or stick, or contract and become loose. Furthermore, by chemical treatment, wood can be strengthened, so that in certain machine parts it can be substituted for steel. It is stated that, in a few days, softer woods can be prepared so that they will be harder than ebony. The chemicals, derived from coal, air, and water, are said to transform wood into substances as different from the original as steel is from wrought iron. It is believed that this new development will increase the importance of forest products in postwar years.

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For T.C.T. Standard Diamond ground single point tools, carried in stock, ask for Bulletin No. 44-1A.

For T.C.T. Carbide Blanks carried in stock, ask for Bulletin No. 44-2A.

Hardened Shanks Boost Carbide Reamer Life

T.C.T. carbide reamers—CARRIED IN STOCK in standard sizes—are not just carbide *tipped*. They are designed and produced to take full advantage of the faster cutting and higher hole accuracy made possible by cemented carbides.

Every T.C.T. stock or special carbide tipped reamer has the shank back of the tips hardened to provide greater strength and reduced flute wear. As a result, the carbide tips have an even longer precision cutting life. Furthermore, all tips are diamond ground—while the O.D. is held to plus 0.0003 in., minus zero.

Available from stock in both straight and taper shank styles. Generous tip width enables securing of many special reamer sizes by simple re-grinding of the O.D. (either at T.C.T. at slight added cost, or in your own shop).

For sizes carried in stock and prices, write or wire for Stock Tool Bulletin No. 43-1.

TUNGSTEN CARBIDE TOOL Company

2661 Joy Road, Detroit 6, Michigan

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News of the Industry

California

WHITMAN & BARNES DIVISION of UNITED DRILL & TOOL CORPORATION, Detroit 16, Mich., has recently opened a new branch at 2305 E. 8th St., Los Angeles 21, Calif., where a complete line of twist drills, reamers, and other W & B tools will be kept in stock. E. L. FOREMAN is manager of the new branch. He was formerly manager of the New York branch of the company. LEE W. SHETLER will assist Mr. Foreman in the Los Angeles and southern California area. B. J. ROHDE represents the company in San Francisco and northern California, as well as in the states of Utah and Nevada. W. J. DICK is representative for the states of Oregon, Washington, Montana, and Idaho.

H. A. S. HOWARTH, who was for twenty-one years general manager and chief engineer of the Kingsbury Machine Works, Philadelphia, Pa., manufacturer of pivoted thrust bearings, has joined the Production Engineering Co., 940 Dwight Way, Berkeley 2, Calif. Subsequent to his association with the Kingsbury Machine Works, Mr. Howarth formed the Howarth Bearing Co. of Philadelphia, which he operated for a number of years.

K. T. VANGSNES, long associated with the aircraft industry on the West Coast, has been named head of the Magnesium Division of the Los Angeles office of the Dow Chemical Co., at 634 S. Spring St., Los Angeles, Calif. For the last five years, he has been vice-president of Magnesium Products, Inc., of Los Angeles.

Illinois and Indiana

FRED BELL, JR., has been appointed manager of the recently opened Chicago office of the Felker Mfg. Co., Torrance, Calif., and will supervise the sale of Di-Met diamond abrasive wheels and Di-Met machines throughout the Chicago area. The Chicago office is at 142 E. Ontario St. For the last eight years, Mr. Bell has been manager of the Detroit office of the Dole Valve Co.

D. J. STEWART, previously assistant general manager of the Barber-Colman Co., Rockford, Ill., has been made vice-president and general manager, succeeding EARLE D. PARKER. H. F. COLLINS, formerly assistant general superintendent, has been appointed works manager of the company.

VINCENT MANKA has been appointed assistant to the president of the Claud S. Gordon Co., 3000 S. Wallace St., Chicago, Ill. Mr. Manka will handle the distribution of information to the metal industries concerning new developments in the pyrometer, furnace, and metallurgical fields.

O. ONSRUD has been elected chairman of the board of the Onsrud Machine Works, Inc., Chicago 47, Ill., and R. F. ONSRUD has been made president and general manager. J. KNOX was elected secretary.

MANCO MFG. CO., Bradley, Ill., manufacturer of bolt and wire cutters, has purchased the Carolus line of bolt and wire cutters, end cutters, and nut splitters. Stocks of replacement parts for Carolus cutters now in service will be maintained.

DELMAR DEWOLF has been appointed advertising manager of Skilsaw, Inc., Chicago, Ill. Mr. DeWolf was previously assistant advertising manager of the company and editor of the *Skilsaw Blade* for three years.

CONTINENTAL ROLL & STEEL FOUNDRY CO., 144th St., and Railroad Ave., East Chicago, Ind., announces that the firm name has been changed to the CONTINENTAL FOUNDRY & MACHINE CO.

Michigan

DR. WILLARD HENRY DOW, president of the Dow Chemical Co., Midland, Mich., has been selected as the recipient of the Gold Medal Award of the American Institute of Chemists for the year 1944. Dr. Dow was awarded the medal for his activities in producing magnesium for use in making airplanes and styrene to supply present needs for synthetic rubber. The medal will be presented at the annual meeting of the Institute in New York City on May 13. Dr. Dow is regarded as one of the foremost leaders of research in the country. His vision has opened new avenues of chemical development and has inspired young chemists to greater endeavor.

Dr. Willard H. Dow, Recipient of the American Institute of Chemists' Gold Medal Award

DOW CHEMICAL CO. opened a new office in Detroit, Mich., on April 1, the third new office to be opened within three months. WALTER J. TRUETTNER will head the Detroit office. He has been associated with the Dow Magnesium Corporation since February, 1942. RALPH B. EHLERS, who has been assistant chief engineer of the Dow Magnesium Corporation since 1942, will be located at the new office, in charge of magnesium distribution and service in southeastern Michigan. Other members of the Detroit office will be PAUL M. JENSEN, in charge of plastics, and FIELDING H. YOST, JR., in charge of industrial chemicals and pharmaceuticals

Walter J. Truettner, Head of the Dow Chemical Co.'s Newly Opened Detroit Office

HOLE ENGINEERING SERVICE announces that it has moved to new quarters at 13722 Linwood Ave., Detroit 6, Mich., which afford greatly expanded facilities. The company also announces

Introducing the KENNAMILL

Partially completed cut illustrating method of flycutting in steps—note bright, smooth finish obtained

A sensational Kennametal achievement—the KENNAMILL—can give new life to your milling machines . . . adapting them for the high speed milling of steel that is inherent in modern, negative rake carbide cutters. At the same time, the Kennamill can improve the quality of your work by producing finished surfaces that are exceptionally smooth and accurate.

Kennamills are inserted-blade cutters, available in four sizes with taper shanks to fit standard spindles, as listed below. All sizes use the same 5/8" square, 10° negative back rake Kennametal-tipped blade (Cat. No. 39M40). Two sets of blades are supplied with each cutter head.

The low initial cost of Kennamills is combined with economy of blade maintenance. No expensive grinding equipment is needed—the blades are easily removed from the cutter head and resharpened to a template on a simple adjustable table carbide grinder. Accurate resetting in the head is not necessary since each blade cuts an independent path.

The use of Kennamills assures optimum machine performance. The sturdiness of the cutter body, plus distribution of the work over the keen-cutting Kennametal-tipped blades, minimizes vibration and chatter, smoothes out the load, and fully utilizes available horsepower, with feeds up to 21" per minute.

Kennamills are available for immediate delivery. They are stocked at our factory, and at Kennametal offices in Atlanta, Chicago, Detroit, Houston, Los Angeles, Philadelphia, New York, and San Francisco. Get in tune with the fast-moving tempo of carbide steel milling—order Kennamills today.

PRICES OF KENNAMILLS

(Complete, with 2 sets of No. 39M40 Kennametal-tipped blades)

Size	Fits Spindle	No. of Blades in Cutter	Price Each
2"-40	#40	3	$31.91
2"-50	#50	3	35.41
3"-40	#40	4	39.99
3"-50	#50	4	41.22
4"-50	#50	4	43.04
5"-50	#50	4	44.85

Extra Blades (No. 39M40) each $1.83

Templates—for regrinding blades—each $1.75

KENNAMETAL

R CEMENTED CARBIDES

KENNAMETAL *Inc.*, 147 LLOYD AVE., LATROBE, PA.

that, in addition to supplying equipment for producing holes, it is now prepared to design and manufacture special equipment on a contract basis.

W. R. DIXON of the Dow Chemical Co., Midland, Mich., has been appointed assistant manager of the company's Plastic Engineering Division. Mr. Dixon joined the Dow organization in 1936, and since 1941 has been handling many of the company's wartime plastic projects in consultation with Washington authorities.

NUTT MOTOR REBUILDERS, 1415 Twelfth St., Detroit 16, Mich., are equipping a thoroughly modern plant or the rebuilding of automobile engines. This plant will be provided with machine tool equipment and conveyor systems, dynamometer room, and block-testing equipment.

MODERN COLLET & MACHINE CO., Ecorse, Mich., has erected a new factory building on the site of the former plant which was destroyed by fire December 25. The company is now back in production. BROWNEY MASCOW is general manager of the company, and JOSEPH MAGYAR factory manager.

New England

RALPH S. HOWE was elected vice-president and manager of the New Britain-Gridley Machine Division, New Britain Machine Co., New Britain, Conn., at a recent meeting of the board of directors. He will have charge of sales. Mr. Howe has been connected with the company since 1920, formerly holding the offices of treasurer and factory manager. JULIAN C. PEASE was elected assistant secretary and factory manager of the MACHINE TOOL DIVISION, and WILLIAM J. LOFGREN was elected treasurer to succeed Mr. Howe.

Ralph S. Howe, Vice-president and Manager of New Britain-Gridley Machine Division of New Britain Machine Co.

Julian C. Pease, Newly Elected Assistant Secretary and Factory Manager of Machine Tool Division, New Britain Machine Co.

R. T. PALMER CO., West Hartford, Conn., has been appointed New England representative for the Gage and Precision Instrument Division of the Sheffield Corporation, Dayton, Ohio.

FREDERICK W. MCINTYRE, SR., formerly vice-president and general manager of the Reed-Prentice Corporation, Worcester, Mass., was elected president at a recent meeting of the board of directors. RALPH E. THOMPSON, formerly president was made chairman of the board. CHARLES S. PAYSON was elected treasurer, and FREDERICK W. MCINTYRE, JR., assistant to the president.

LOVEJOY TOOL CO., INC., Springfield, Vt., announces the following new sales representatives: WALTER F. GREENE, 658 Fairfield Ave., Indianapolis 5, Ind., and the DON HALL TOOL CO., 20 N. Wacker Drive, Room 2223, Chicago, Ill.

New York

T. F. WILSON, formerly assistant to the senior vice-president of the American Car & Foundry Co., 30 Church St., New York City, has been appointed assistant to the president. J. A. V. SCHECKENBACH, who was recently elected vice-president, has been placed in charge of manufacturing, and in addition, will have charge of improvements and maintenance in all the plants of the company.

ALEXANDER M. HAMILTON has been appointed vice-president in charge of foreign sales of the American Locomotive Co., 30 Church St., New York City. At the present time, he is serving as executive vice-president of the Montreal Locomotive Works, Ltd., a Canadian subsidiary of the American Locomotive Co. He has had wide experience in foreign service.

NATIONAL TECHNICAL INSTITUTE, INC., announces that its main office has been moved to 55 W. 42nd St., New York 18, N. Y., where the aircraft, mechanical, and architectural drafting day and night courses will be continued. The Aircraft Instrument School will continue at its present address, 116 Newark Ave., Jersey City, N. J.

A. F. RUCKS was elected president and general manager of the C. J. Tagliabue Mfg. Co., Brooklyn, N. Y., manufacturer of indicating, recording, and controlling instruments, at a recent meeting of the board of directors. He succeeds the late C. D. WATERS. Mr. Rucks has been associated with the company for over thirty years.

ROBERT S. ARCHER has joined the Climax Molybdenum Co., 500 Fifth Ave., New York 18, N. Y., in the capacity of metallurgical assistant to the vice-president. He was previously chief metallurgist of the Republic Steel Corporation in the Chicago district.

H. R. METZ has been appointed works manager of the Eisemann Corporation, Brooklyn, N. Y., manufacturer of magnetos, generators, fuel injection systems, etc. LLOYD H. SCOTT has been made chief engineer of the corporation.

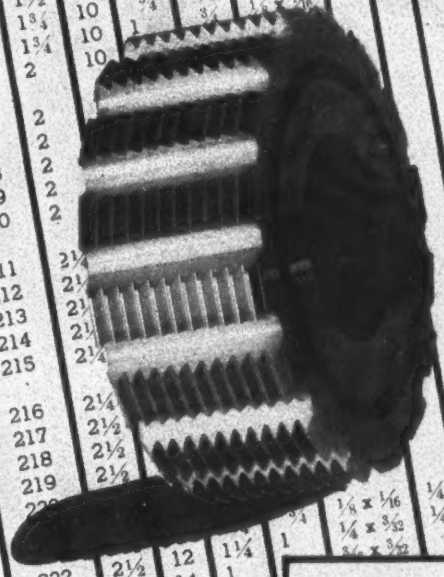
DR. V. N. KRIVOBOK, for many years professor of metallurgy at the Carnegie Institute of Technology, has become associated with the Development and Research Division of the International Nickel Co., 67 Wall St., New York City.

BEN BUERK, president of the Buerk Tool Works, Buffalo, N. Y., has been appointed national counsellor to the United States Chamber of Commerce for the National Tool and Die Manufacturers Association, Washington, D. C.

GILBERT BUTLER has been made president of the Bossert Co., Inc., Utica, N. Y., manufacturer of pressed-metal parts, in place of FRANCIS K. KERNAN, who died recently. Mr. Butler will also serve as general manager of the company.

ROGERS MACHINE WORKS, INC., manufacturers of Rogers "Perfect 36" vertical turret mills, have moved their general and sales offices to larger and more centrally located quarters at 1807 Elmwood Ave., Buffalo 7, N. Y.

HOW TO GET THREAD MILLING CUTTERS *Faster*



SHELL TY

List No.	Diameter A	No. of Flutes B	Face Width C	Hole Size D	Keyway E
201	1½	8	½	⅝	⅛ x 1/16
202	1½	8	¾	⅝	⅛ x 1/16
203	1¾	10	¾	¾	⅛ x 1/16
204	1¾	10	1	¾	⅛ x 1/16
205	2				
206	2				
207	2				
208	2				
209	2				
210	2				
211	2¼				
212	2¼				
213	2¼				
214	2¼				
215	2¼				
216	2¼				
217	2½				
218	2½				
219	2½				
222	2½	12	1¼		
223	3	14	1		
224	3	14	1		
225	3	14	1		
226	3	14	1¼		
227	3	14	1½		
228	3	14	2		
229	3	14	2		
230	3	14	2		
231	3	14	2		
232	3½	16	2		
233	3½	16	2		
234	3½	16	2		
235	3½	16	2		
236	3½	16	2		
237	3½	16	2		
238	3½	16	2		
239	3½	16	2		
240	3½	16	2		

Order by

STOCK BLANK NUMBER

giving Pitch and Thread Form desired

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DETROIT

STANDARD STOCK BLANKS MEET 90% OF ALL THREAD MILLING CUTTER REQUIREMENTS

SHANK TYPE

List No.	A Diameter Thread Section	B Number of Flutes	C Width of Face	D Length of Shank	E Length Overall	F Shank Diameter Large End	G Shank Taper: Jarno	G Shank Taper: Brown & Sharpe	G Shank Taper: Morse	H Drawbar Threads
101				3 11/16	5¼	.884	7			½-13NC
102						.922		8		¾-24NF
103									3	½-13NC
10										½-13NC
105										¾-24NF
106	1									½-13NC
107	1¼	8	1½							½-13NC
108	1¼	8	1½	4⅞	6¾					¾-24NF
109	1¼	8	1½	3⅛	5½	.948				½-13NC
110	1½	8	1½	4 11/16	6¾	1.134	9			½-13NC
111	1½	8	1½	4⅞	6¾	1.271		10		¾-24NF
112	1½	8	1½	3⅛	5½	.948			3	½-13NC

FOR STANDARD STOCK SIZES, ASK FOR BULLETIN No. CB-43

BUY U.S. BONDS STAMPS

DETROIT TAP & TOOL CO.

8432 BUTLER
DETROIT 11
MICH. U.S.A.

New Jersey

HARRY E. SMITH, general manager of the Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J., and ROBERT B. DAVIS, general manager of the Raybestos Division, Stratford, Conn., were elected vice-presidents of Raybestos-Manhattan, Inc., at a recent meeting of the board of directors. All other officers of the company were re-elected.

Ohio

FRED H. MARKWICK has been appointed general plant manager of the Manufacturing Division of the Sheffield Corporation, Dayton 1, Ohio. Mr. Markwick has been a member of the Sheffield organization since 1917, and came up through the ranks. Previous to his present appointment, he was plant manager of the Gage Manufacturing Division.

Fred H. Markwick, General Plant Manager, Manufacturing Division, Sheffield Corporation

OHIO STAINLESS STEEL CO. has been organized by PAUL KELLER and E. B. FARRIS, with offices at 1048 Union Commerce Bldg., Cleveland, Ohio, to specialize in all types of stainless-steel products. A number of companies producing stainless steel will be represented by the Ohio Stainless Steel Co. in the Central West, including the Jessop Steel Co., Washington, Pa., the Joslyn Mfg. & Supply Co., Chicago, Ill., and the Babcock & Wilcox Tube Co., Beaver Falls, Pa. Mr. Keller and Mr. Farris were both formerly associated with the Copperweld Steel Co., Warren, Ohio.

AL J. MCCULLOUGH and JACK E. MACCONVILLE have been placed in joint charge of industrial instrument sales for the Brown Instrument Division of the Minneapolis-Honeywell Regulator Co. at the Cleveland, Ohio, office. KENTNER L. WILSON has been made branch manager of the Detroit office of the Minneapolis-Honeywell Regulator Co.

GORDON LEFEBVRE, president and general manager of the Cooper-Bessemer Corporation, Mount Vernon, Ohio, and FRED V. GARDNER, head of the firm of Fred V. Gardner & Associates, Milwaukee, Wis., were elected directors of the National Tool Co., Cleveland, Ohio, at a recent meeting of the stockholders.

J. K. GANNETT, vice-president of the Austin Co., Cleveland, Ohio, has been appointed director of engineering, in charge of engineering and research. Mr. Gannett has been eastern district manager of the company since 1928. He is a graduate of the University of Michigan, and joined the Austin Co. in 1915.

FOUNDRY EQUIPMENT MANUFACTURERS ASSOCIATION announces that the offices of the association have been moved to larger quarters in the Engineers Building, Cleveland 14, Ohio.

EVANS REAMER & MACHINE CO., Chicago, Ill., formerly known as the Evans Reamer Co., has moved to a new and larger plant in New Lexington, Ohio.

Oklahoma and Georgia

HAROLD JOE DAVIS, 4212 S. 26th West Ave., Tulsa 7, Okla., who at the time of Pearl Harbor, gave up his established business as a consultant and advisor to industrial managements on problems of fire prevention to volunteer in the service of his country, and who was severely wounded at Dutch Harbor, Alaska, has completely recovered and is again available to an organization that can make use of his services. While in the Government service, Mr. Davis was assigned to the Fire Administration in an executive capacity. He is the author of a number of technical books.

G. E. HUNT has been appointed acting manager of the Atlanta, Ga., territory of Cutler-Hammer, Inc., Milwaukee, Wis. The Atlanta offices and warehouse are located at 134 Marietta St., N. W.

Pennsylvania

ELLIS L. SPRAY has been appointed assistant to the president of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and will have charge of the Headquarters Manufacturing Division in Pittsburgh. His duties will include such problems as coordination of the company's manufacturing divisions, quality control, and methods of production. He was previously manager of the company's Merchant Marine Division at Lester, Pa.

BEARINGS CO. OF AMERICA, Lancaster, Pa., announces the election of the following officers at the annual meeting of the board of directors: JACK L. STRAUB, chairman of the board; HENRY W. JACKSON, president, and CHARLES D. ADDAMS and JOHN I. HARTMAN, vice-presidents.

JOHN H. ELLIOTT, for the last four years secretary of the Landis Machine Co., Waynesboro, Pa., has been appointed general manager. He will also continue his duties as secretary.

PAUL L. GOLDSTROHM and GEORGE M. MUSCHAMP have been elected members of the board of directors of the Brown Instrument Co., Philadelphia, Pa., manufacturer of precision industrial instruments.

Wisconsin

SOREN H. MORTENSEN, chief electrical engineer for Allis-Chalmers Mfg. Co., Milwaukee, Wis., was recenty awarded an honorary Doctor of Engineering degree by the Illinois Institute of Technology at Chicago "for distinguished leadership in the development of alternating-current machinery."

WILLIAM C. JOHNSON, JAMES M. WHITE, and WILLIAM A. ROBERTS were recently elected vice-presidents of the Allis-Chalmers Mfg. Co., Milwaukee, Wis.

JOHN AVERY has been appointed manager of the blower and compressor department of the Allis-Chalmers Mfg. Co., Milwaukee, Wis. He succeeds G. L. KOLLBERG, who is retiring after forty-seven years of service with the company. Mr. Kollberg will continue to act as consultant to the company and advisor on engineering matters.

FRANK M. BLUM has been appointed manager of the Crane Sales Division of Harnischfeger Corporation, Milwaukee, Wis. Mr. Blum succeeds BEN VAN HORN who has retired after forty-seven years of continuous association with the company.

A. O. SMITH CORPORATION, Milwaukee, Wis., has appointed the PACIFIC METALS CO. LTD., 3100 Nineteenth St., San Francisco, Calif., distributor in California, Nevada, and Arizona for Smith welding equipment.

ACRO WELDER MFG. CO. announces its removal to 1825 W. St. Paul Ave., Milwaukee 3, Wis. DANIEL D. EYSTER has recently been appointed manager.

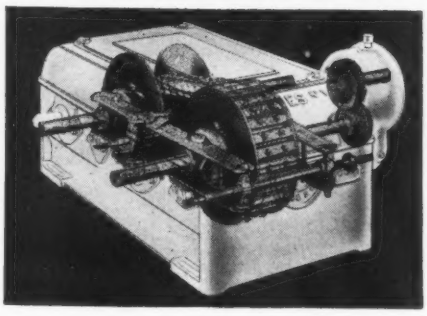
REEVES Transmission

Stepless Speed Adjustability and Speed Reduction in One Compact Unit

Here is a new REEVES Variable Speed Control unit, which consists of the widely preferred REEVES Variable Speed Transmission with built-in, helical-type speed reducer.

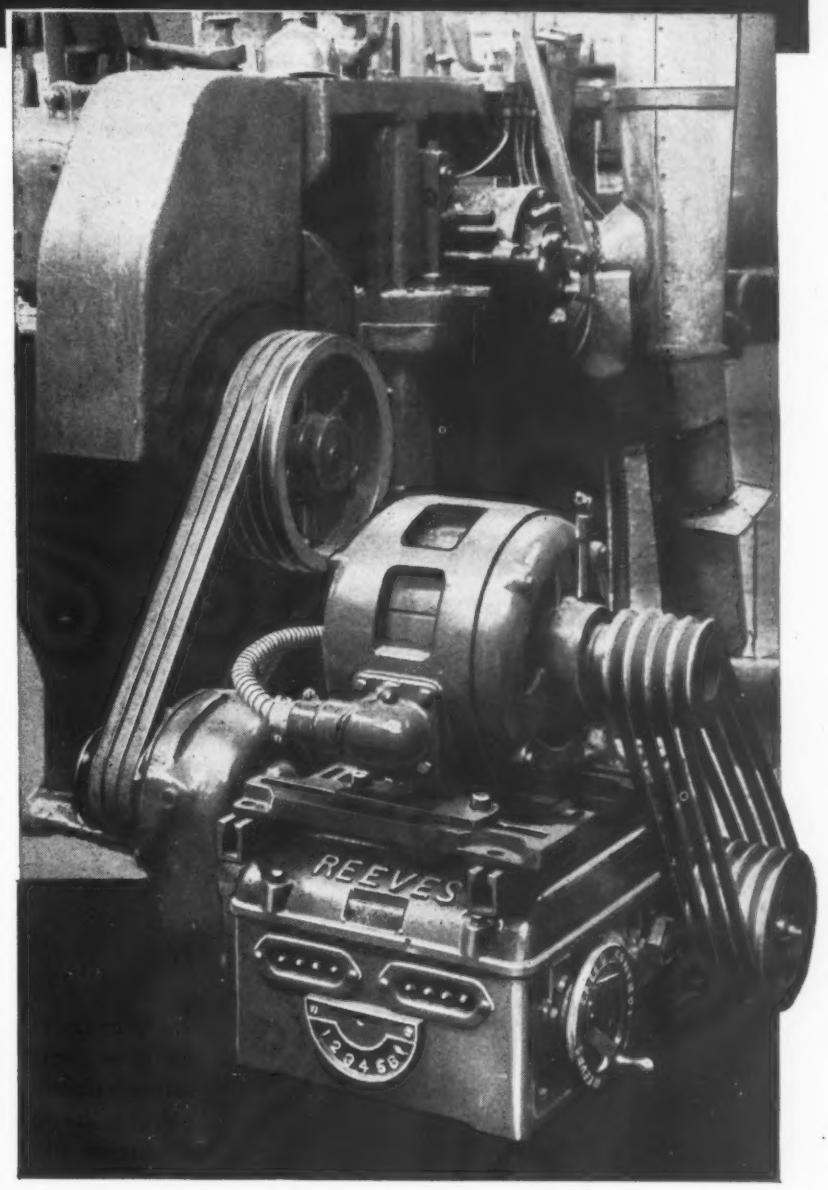
An outstanding advantage of this modern, highly efficient drive is that far less mounting space is needed to obtain the lower output speeds which formerly required the use of auxiliary speed reducing equipment.

The REEVES Reducer-Type Transmission is built in two completely enclosed designs —horizontal and vertical. Either of these designs is available in many different horse power capacities and ranges of speed variation, and may be mounted in almost any position on or near the driven machine. Either design may be equipped for individual motor drive by use of the REEVES adjustable motor base, as shown in the installation at right. Any available motor can be accommodated. Speed shifting controls may be handwheel, electric remote or completely automatic. Send for catalog **MTR-432**, giving complete information.



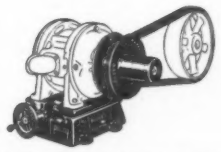
"X-ray" view shows how pinion of reduction gears is mounted on variable speed shaft of Transmission, this shaft serving as input shaft for reducer unit.

REEVES PULLEY COMPANY
COLUMBUS • INDIANA

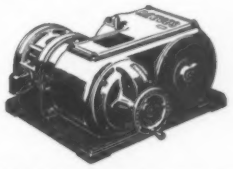


THE 3 BASIC UNITS IN THE REEVES LINE

VARIABLE SPEED TRANSMISSION for providing infinite, accurate speed flexibility over wide range, 2:1-16:1. To 87 h.p.



VARI-SPEED MOTOR PULLEY converts any standard constant speed motor to a variable speed drive. In sizes to 15 h.p.



MOTODRIVE combines motor, speed varying mechanism and reduction gears in a single unit. In sizes to 15 h.p. capacities.

REEVES *Accurate Variable* SPEED CONTROL

Obituaries

Fred S. Doran

Fred S. Doran, vice-president of Joseph T. Ryerson & Son, Inc., Chicago, Ill., died on March 24 in Chicago. He became associated with the company in 1905 as a very young man and worked up through many departments, from office boy to the position of vice-president. Mr. Doran represented the firm in Wisconsin and southern Minnesota for a number of years, and in 1920, became assistant sales manager of the Chicago plant. In 1927, he was made manager of the Cleveland plant, and in 1941, was transferred back to the general offices in Chicago to assume responsibility in connection with the war effort. In 1942, he was elected vice-president of the company.

Mr. Doran was one of the most experienced and best known men in the steel industry. He was a member of the American Steel Warehouse Association and of the American Iron and Steel Institute. He was helpful to everyone with whom he came in contact, and leaves many friends in all walks of life.

F. F. McIntosh

Frederick Fleming McIntosh, director of metallurgy of the Crucible Steel Co. of America, New York City, died on February 23 at the Sewickley Valley Hospital, Sewickley, Pa., after a short illness. Mr. McIntosh was born on August 12, 1879, at Glen Osborne, Sewickley, Pa. He graduated from Phillips Exeter Academy in 1899, and obtained a B.S. degree from Harvard University in 1903. In 1905, he received the first degree in metallurgy ever granted by Harvard University.

Shortly after graduation, he went to work for the Crucible Steel Co. of America at the LaBelle Works, and remained there for two years. His next position was with the Bethlehem Steel Co. in the company's special training course. After spending two years at the Bethlehem plant, in 1907 he was appointed assistant professor of metallurgy at the Carnegie Institute of Technology, which position he held until 1917, when he resigned to go into the Army. After the war, he returned to the Carnegie Institute of Technology as associate professor of metallurgy and remained there until 1926, when he returned to the Crucible Steel Co. of America as chief metallurgist. In 1939, he was made director of metallurgy for the company, in which capacity he served until his death.

He was a member of the American Institute of Mining and Metallurgical Engineers, the British Iron and Steel Institute, the American Society for Metals, and the Engineers Society of Western Pennsylvania. He had also served as metallurgical consultant of the Watertown Arsenal.

FRANCIS K. KERNAN, president of the Bossert Co., Inc., Utica. N. Y., manufacturer of pressed-metal parts, died on March 11. Under Mr. Kernan's leadership, the company became a pioneer in the art of stamped, pressed, and drawn metals, and has maintained a position in the front ranks of this industry. Mr. Kernan was a prominent lawyer, and was active in several lines of manufacturing. He was a director and member of the executive committee of the Equitable Life Assurance Society of the United States, and a director of several manufacturing corporations. His loss will be keenly felt by a wide circle of friends.

FRANK B. WILKINSON, founder of the Logansport Machine Co., Inc., died at his home in Logansport, Ind., on March 23, after a lingering illness, at the age of eighty-seven. Mr. Wilkinson was born in Belmont County, Ohio, in 1856. He had resided in Logansport for forty-four years, where he was instrumental in founding several manufacturing companies. In 1916, he formed the Logansport Machine Co., Inc., to manufacture air- and hydraulic-operated equipment. The growth of the business twice made increased space necessary, and in 1929, the company acquired the present plant location. Mr. Wilkinson had not been active in the business for several years.

JAMES STEWART NICOLL, pioneer steel man and vice-president of the Kelly O'Leary Steel Works, Chicago, Ill., died on March 29, following an illness of several months. Mr. Nicoll was born in Chicago in 1891. At the age of seventeen, he became connected with the Kelly O'Leary Steel Works, with whom he was associated up to the time of his death.

Coming Events

MAY 18-20—Spring meeting of the SOCIETY FOR EXPERIMENTAL STRESS ANALYSIS, including a Symposium on Residual Stresses—Their Measurement and Effects. Headquarters, Hotel Statler, Boston, Mass. Further information can be obtained from the Society, P. O. Box 168, Cambridge 39, Mass.

MAY 22-24—Twenty-eighth annual meeting of the AMERICAN GEAR MANUFACTURERS ASSOCIATION at the Westchester Country Club, Rye, N. Y. Newbold C. Goin, executive secretary, Empire Bldg., Pittsburgh 22, Pa.

JUNE 5-7 — National War Materiel Meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Book-Cadillac Hotel, Detroit, Mich. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

JUNE 19-22—Semi-annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at the William Penn Hotel, Pittsburgh, Pa. Clarence E. Davies, secretary, 29 W. 39th St., New York 18, N. Y.

JUNE 26-30—Forty-seventh annual meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Waldorf-Astoria Hotel, New York City. For further information, address American Society for Testing Materials, 260 S. Broad St., Philadelphia 2, Pa.

SEPTEMBER 28-30—Convention of the NATIONAL TOOL AND DIE MANUFACTURERS ASSOCIATION in Buffalo, N. Y.; headquarters, Hotel Statler. General manager, M. W. Rowell, Southern Building, Washington, D. C.

OCTOBER 2-5—Fall meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at the Netherland-Plaza Hotel, Cincinnati, Ohio. Clarence E. Davies, secretary, 29 W. 39th St., New York 18, N. Y.

OCTOBER 5-7—Aircraft Engineering and Production Meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Hotel Biltmore, Los Angeles, Calif. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

OCTOBER 12-14—Semi-annual meeting of the AMERICAN SOCIETY OF TOOL ENGINEERS at Syracuse, N. Y. Adrian L. Potter, executive secretary, 2567 W. Grand Blvd., Detroit 8, Mich.

OCTOBER 16-20—Twenty-sixth annual meeting of the AMERICAN SOCIETY FOR

SIZES AND PROPERTIES OF PIPE—3

Welded and Seamless Wrought-Iron and Wrought-Steel Pipe—Schedule 80, American Standards Association B-36-10

Diameter, Inches			Wall Thickness, Inches	Area, Square Inches			Circumference, Inches		Weight per Foot, Pounds			Threads per Inch	Normal Engagement by Hand of Thread, Inches	Tap Drill Size, Inches
Nominal	Actual Inside	Actual Outside		Of Circle with Outside Diameter	Of Circle with Inside Diameter	Cross-Section of Metal	Outside	Inside	Of Pipe	Of Water in Pipe	Of Pipe and Water			
1/8	0.215	0.405	0.095	0.12	0.0363	0.093	1.27	0.675	0.314	0.0099	0.3239	27	0.180	11/32
1/4	0.302	0.540	0.119	0.22	0.0716	0.157	1.69	0.943	0.535	0.0310	0.5660	18	0.200	7/16
3/8	0.423	0.675	0.126	0.35	0.1405	0.217	2.12	1.328	0.738	0.0610	0.7990	18	0.240	37/64
1/2	0.546	0.840	0.147	0.55	0.2341	0.320	2.65	1.715	1.087	0.1020	1.1890	14	0.320	45/64
3/4	0.742	1.050	0.154	0.86	0.4324	0.433	3.29	2.330	1.473	0.2130	1.6860	14	0.340	29/32
1	0.957	1.315	0.179	1.35	0.7193	0.639	4.13	3.010	2.171	0.3120	2.4830	11 1/2	0.400	1 9/64
1 1/4	1.278	1.660	0.191	2.16	1.2830	0.881	5.21	4.010	2.996	0.5550	3.5510	11 1/2	0.420	1 1/2
1 1/2	1.500	1.900	0.200	2.83	1.7670	1.068	5.96	4.720	3.631	0.7650	4.3960	11 1/2	0.420	1 23/32
2	1.939	2.375	0.218	4.43	2.9530	1.477	7.46	6.090	5.022	1.2800	6.3020	11 1/2	0.440	2 3/16
2 1/2	2.323	2.875	0.276	6.49	4.2380	2.254	9.03	7.320	7.661	1.8300	9.4910	8	0.680	2 11/16
3	2.900	3.500	0.300	9.62	6.6050	3.016	10.96	9.120	10.252	2.8700	13.1220	8	0.770	3 5/16
3 1/2	3.364	4.000	0.318	12.56	8.8910	3.678	12.56	10.580	12.505	3.7200	16.2250	8	0.820	3 13/16
4	3.826	4.500	0.337	15.30	11.5000	4.407	14.13	12.020	14.983	4.9700	19.9530	8	0.850	4 5/16
5	4.813	5.563	0.375	24.29	18.1900	6.112	17.47	15.150	20.778	7.9400	28.7180	8	0.940	5 3/8
6	5.761	6.625	0.432	34.47	26.0700	8.405	20.81	18.100	28.573	11.3000	39.8730	8	0.960	6 7/16
8	7.625	8.625	0.500	58.42	45.6600	12.760	27.09	24.000	43.388	19.8000	63.1880	8	1.060	8 7/16
10	9.564	10.750	0.593	90.79	71.8400	18.920	33.77	30.050	64.400	31.1300	95.5300	8	1.210	10 9/16
12	11.376	12.750	0.687	127.67	101.6400	26.030	40.05	35.720	88.600	44.0400	132.6400	8	1.360	12 9/16
14	12.500	14.000	0.750	176.71	122.7200	31.220	47.12	39.270	107.000	53.1800	160.1800	8	1.560	13 13/16
16	14.314	16.000	0.843	226.98	160.9200	40.140	53.41	44.970	137.000	69.7300	206.7300	8	1.810	15 13/16
18	16.126	18.000	0.937	254.47	204.2400	50.230	56.55	50.660	171.000	88.5000	259.5000	8	2.000	17 13/16
20	17.938	20.000	1.031	314.16	252.7200	61.440	62.83	56.350	209.000	109.5100	318.5100	8	2.125	19 13/16
24	21.564	24.000	1.218	452.39	365.2200	87.170	75.40	67.750	297.000	158.2600	455.2600	8	2.375	23 13/16

Compiled by J. Lewis Luckenbach

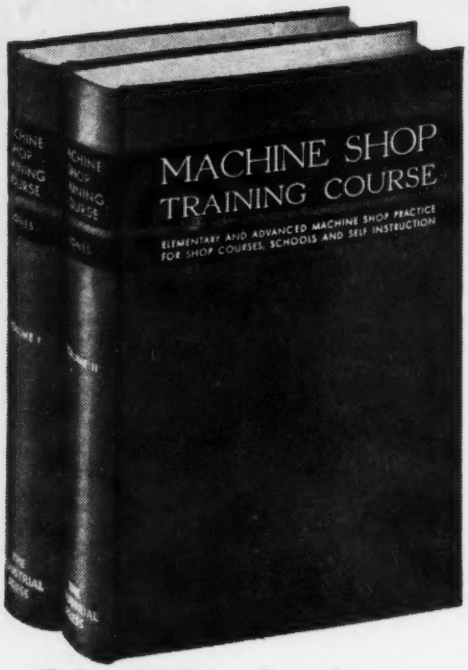
SIZES AND PROPERTIES OF PIPE—4

Welded and Seamless Wrought-Iron and Wrought-Steel Pipe—Schedule 80, American Standards Association B-36-10

Nominal Diameter, Inches	Properties				Length of Pipe per Square Foot of Surface		Square Feet of Surface per Foot of Pipe		Capacity of Pipe per Foot of Length			Length of Pipe in Feet to Contain	
	Moment of Inertia	Radius of Gyration	Section Modulus	Torsion Section Modulus	Outside, Feet	Inside, Feet	Outside, Sq. Feet	Inside, Sq. Feet	In Cubic Inches	In Cubic Feet	In Gallons	One Cubic Foot	One Gallon
1/8	0.001216	0.1203	0.00597	0.01195	9.431	17.750	0.106	0.0562	0.432	0.000326	0.0019	3070.000	527.000
1/4	0.003766	0.1590	0.01392	0.02783	7.073	11.920	0.141	0.0785	0.865	0.000520	0.0037	1920.000	271.000
3/8	0.008619	0.1770	0.01753	0.03506	5.658	9.080	0.177	0.1106	1.692	0.000980	0.0073	1370.000	137.000
1/2	0.020080	0.2500	0.04704	0.09408	4.547	7.080	0.221	0.1428	2.808	0.001620	0.0122	616.000	82.000
3/4	0.044790	0.3270	0.08656	0.17312	3.637	4.980	0.275	0.1940	5.196	0.003000	0.0255	334.000	39.200
1	0.105600	0.4050	0.15730	0.31460	2.904	4.000	0.344	0.2510	8.628	0.005000	0.0374	200.000	26.800
1 1/4	0.241800	0.5220	0.28830	0.57660	2.301	2.990	0.435	0.3340	15.400	0.008800	0.0666	114.000	15.000
1 1/2	0.391200	0.6100	0.41450	0.82900	2.010	2.540	0.497	0.3930	21.200	0.012300	0.0918	81.500	10.900
2	0.867900	0.7600	0.71640	1.43280	1.608	1.970	0.622	0.5070	35.440	0.020600	0.1535	49.800	6.520
2 1/2	1.924000	0.9250	1.33590	2.67180	1.328	1.640	0.753	0.6100	50.860	0.029400	0.2200	34.000	4.550
3	3.894000	1.1300	2.21950	4.43900	1.091	1.310	0.916	0.7600	79.260	0.046000	0.3440	21.700	2.910
3 1/2	6.280000	1.3100	3.13470	6.26940	0.954	1.130	1.047	0.8820	106.660	0.061700	0.4580	16.250	2.180
4	9.610000	1.5900	4.26600	8.53200	0.848	1.000	1.178	1.0020	137.960	0.080000	0.5970	12.500	1.675
5	20.67000	1.8400	7.42100	14.8420	0.686	0.790	1.456	1.2620	218.320	0.126000	0.9470	7.950	1.055
6	40.49000	2.1900	12.2000	24.4000	0.576	0.662	1.734	1.5100	312.800	0.182000	1.3550	5.500	0.738
8	105.7000	2.8950	24.8800	49.7600	0.443	0.502	2.258	2.0000	547.960	0.318000	2.3800	3.140	0.420
10	244.3800	3.5900	45.4700	90.9300	0.355	0.399	2.814	2.5030	962.080	0.556000	4.1650	1.800	0.241
12	474.2600	4.2700	74.9800	149.960	0.299	0.336	3.370	2.9750	1219.680	0.706000	5.2800	1.420	0.189
14	689.9200	4.7100	98.5600	197.120	0.250	0.305	3.930	3.2710	1472.640	0.852000	6.3800	1.180	0.157
16	1154.250	5.3500	144.280	288.560	0.220	0.267	4.440	3.7460	1931.040	1.117000	8.3600	0.895	0.119
18	1830.150	6.0300	203.350	406.700	0.210	0.237	4.712	4.2200	2450.880	1.418000	10.6100	0.705	0.094
20	2599.070	6.5100	259.910	519.820	0.190	0.213	5.236	4.6940	3032.640	1.755000	13.1300	0.570	0.076
24	5662.000	8.3500	471.830	943.670	0.160	0.176	6.283	5.6440	4382.640	2.536000	19.0000	0.395	0.052

Compiled by J. Lewis Luckenbach

Machine Shop Training Course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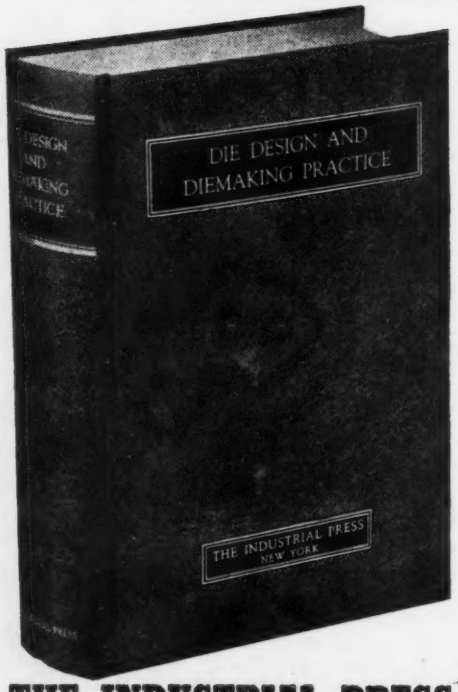

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METALS AND THE NATIONAL METAL CONGRESS, to be held at the Public Auditorium, Cleveland, Ohio. W. H. Eisenman, secretary, American Society for Metals, 7301 Euclid Ave., Cleveland.

NOVEMBER 15-19—THIRD NATIONAL CHEMICAL EXPOSITION in the Chicago Coliseum, Chicago, Ill. M. H. Arveson, chairman, Exposition Committee, American Chemical Society, 330 S. Wells St., Chicago 6, Ill.

NOVEMBER 27-DECEMBER 1—Annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at Hotel Pennsylvania, New York City. Clarence E. Davies, secretary, 29 W. 39th St., New York 18, N. Y.

JANUARY 8-12, 1945—Annual meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Book-Cadillac Hotel, Detroit, Mich. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

New Books and Publications

THOMAS' REGISTER OF MANUFACTURERS (1944). 6200 pages, 9 by 14 inches. Published by the Thomas Publishing Co., 461 Eighth Ave., New York 1, N. Y. Price, $15.

The 1944 edition of this purchasing encyclopedia, covering all manufactured products in the United States, is so much larger than previous editions that it has been necessary to publish it in two volumes. The present edition contains 600 more pages than the previous one. Volume 1, containing 5300 pages, is devoted exclusively to the classified products list, which contains the names and addresses of manufacturers, classified according to products as well as geographically. In addition, size ratings and other informative data are included. More than 70,000 products are covered in this section. These are classified not only by the generalized or group names, but by specific types, so that the buyer can readily locate the particular kind of product that will best meet his requirements.

Volume 2 (900 pages) contains an alphabetical list of the manufacturers included in Volume 1, as well as an alphabetical list of the trade names of the various products. The alphabetical list of manufacturers includes products, and in many cases, branches, subsidiaries, and other data. Volume 1 is bound in cloth and Volume 2 in a flexible paper binding. This book, through its thirty-three years of publication, has proved of inestimable value to purchasing departments, sales departments, and executives in general who desire to make a list of products or of firms for various purposes. The book is thoroughly indexed and cross-indexed.

TREATISE ON PLANERS. 133 pages, 6 by 9 inches. Published by the Cincinnati Planer Co., Cincinnati, Ohio. Price, $1.

This is the third edition of a treatise on planers, discussing the fundamental principles of accurate planing. The book has been prepared especially to aid all those who own or operate planers to secure the best results from them. It should be of value in selecting the proper machines for this class of work and in tooling them so as to produce the work at a minimum cost. There are ten chapters dealing with the following subjects: History of the Planer; The Modern Planer; Tools for the Planer; Setting up Work on the Planer; Adjustable Planer Stop; Cutting Speeds; Planing Locomotive Cylinders; Examples of Planer Work; Types of Planers; and Details of Planer Construction.

ANGULAR SPACING TABLES. Computed and compiled by Dr. Werner F. Vogel. 236 pages, 8 1/2 by 11 inches. Published by the Vinco Corporation, 8855 Schaefer Highway, Detroit 27, Mich. Price, $10.

This book of angular spacing tables for checking the spacing of teeth in precision gears, splines, index-plates, etc., is the most complete work of its kind thus far published. It was compiled to eliminate time-consuming, mathematical calculations and possible errors involved in making them. The book was prepared especially for use in connection with the Vinco optical dividing head, an instrument used for measuring angles accurately to one second.

The tables give the included angle between any point of beginning and any one or more divisions of a circle up to and including 200 divisions, there being 26,571 values in the complete series of tables. The angular spacings are given in degrees, minutes, seconds, and thousandths of a second. An appendix of value in scientific work and in making exact gear calculations is included consisting of three sections. The first section gives tables of fundamental dividing angles for gears having up to 200 teeth, in degrees, minutes and seconds; in degrees and decimals of a degree; and in radians. The second section contains tables for converting minutes, seconds, and decimals of a second to eight decimals of a degree. The third section gives constant values of pi and its reciprocal to seventy decimal places.

The sheets of this book are lacquered, so that they can be easily cleaned when they become soiled by shop use.

PRACTICAL METALLURGY FOR ENGINEERS. 480 pages, 5 1/2 by 8 1/2 inches. Published by E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa. Price, $3.

This is the fourth edition of a metallurgical guide for engineers, the first edition of which was published about twenty years ago. Obviously, the tremendous expansion of the metal-working industry since that time, the improvements in standards of measurement and testing, and the mechanical aspects of the war have created the need of a new and completely revised edition. While the book deals with fundamentals and established practices in metallurgy, it also includes data on expedients which have been adopted so far in the war emergency, some of which will probably become standard.

The text is divided into twenty-six chapters dealing with the following subjects: The Physics and Chemistry of Metallurgy; Metals and Their Ores; Fuels; Refractories; Non-Ferrous Metals; Iron Ores; Manufacture of Iron and Steel; Mechanical Treatment; Temperature Measurement; Heat-Treatment of Steel; Quenching; Grain Size and Hardenability; Testing and Inspecting; Metallography; Heat-Treating Furnaces; Steels Used for Carburizing; Carburizing Materials; Procedure Control and Equipment; Containers; Selective Casehardening; General Discussion of Carburizing and Hardening Troubles; Liquid Salt Baths; Heat-Treatment of Aluminum Alloys; Steel Classification and Specifications; Service Rendered to the Metal Industry; and Reference Data.

TIME-STUDY FUNDAMENTALS FOR FOREMEN. By Phil Carroll, Jr. 172 pages, 5 by 7 1/2 inches. Published by the McGraw-Hill Book Co., 330 W. 42nd St., New York 18, N. Y. Price, $1.75.

This little manual is intended to give the foreman a working knowledge of the fundamental principles involved in studying and measuring the time it takes to do a job, with a view to improving the efficiency of shop operations, thus increasing production and the earning capacity of the workmen. It is written in a simple non-technical style, being intended primarily as a primer for beginners.

OPERATOR'S INSTRUCTION MANUAL—A HANDBOOK ON UNIVERSAL CUTTER AND TOOL GRINDING. 128 pages, 6 by 9 inches. Distributed by the Covel Mfg. Co., Benton Harbor, Mich. Price, $1.

Recent Army-Navy "E" Production Awards

The following companies in the machine-building and allied fields have recently been awarded the Army-Navy "E" for excellence in production, or a renewal of the Award for continued high production:

American Car and Foundry Co., Wilmington, Del.

Aro Equipment Corporation, Cleveland, Ohio.

Briggs Clarifier Co., Washington, D. C.

Bristol Co., Waterbury, Conn.

Bryant Electric Co., Plastic Division and Wiring Device Division, Bridgeport, Conn.

Buffalo Pumps, Inc., North Tonawanda, N. Y.

Cooper-Bessemer Corporation, Grove City, Pa.

Desmond-Stephan Mfg. Co., Urbana, Ohio.

Divine Brothers Co., Utica, N. Y.

Erie Basin Metal Products, Inc., Elgin, Ill.

General Controls Co., Glendale, Calif.

Heller Brothers Co., Newcomerstown, Ohio.

Illinois Watch Case Co., Elgin, Ill.

D. O. James Mfg. Co., Chicago, Ill.

Lempco Products, Cleveland, Ohio.

Lodge & Shipley Machine Tool Co., Cincinnati, Ohio.

Miami Industries, Inc., Toledo, Ohio.

Verson Allsteel Press Co., Chicago, Ill.

N. A. Woodworth Co., Ferndale, Mich.

* * *

Plastics for Pipe Fittings

The use of plastic materials for joints and fittings, and for tubing, has become so widespread in the aircraft industry, according to *Modern Plastics*, that the National Aircraft Standards Committee has approved standards for thirty-seven fittings, and is working on specifications for tubing and for installations.

Preventing Corrosion of Steel

Corrosion of steel is said to be effectively prevented by the use of a preparation known by the trade name "Sublan," which is made by the Glyco Products Co., Inc., 26 Court St., Brooklyn 2, N. Y. This substance is diluted with an equal amount of thin acid-free mineral oil. In one case, the mixture was applied to highly polished steel surfaces tested in a room where the humidity was kept at from 90 to 95 per cent, with condensate continuously forming on the surface of the steel. A film of the mixture had been applied to the steel by simply cold dipping the steel panel and draining it. After 1200 hours in the humid atmosphere, there was no evidence of the formation of rust. In another instance, polished steel panels protected by the mixture were stored, wrapped in paper, for ten months, after which period they showed no signs of rust. The film is removed by a cold solvent wash or dip.

* * *

Payroll Calculator

A payroll calculator, known as the "Wage-Master," has been developed by the Wage-Master Co., 1751 Belmont Ave., Chicago 13, Ill. This device automatically computes any wage-hour payroll calculation within its range easily and quickly. The operator of the device sees at a glance four values: (a) Wages at straight time; (b) premium wages; (c) wages at time and a half on time over forty hours; and (d) total wages earned. The range of the device covers 234 wage rates from 30 cents to $2.12½ per hour and from 0.1 hour to 64.9 hours.

* * *

Nylon is being successfully used in paint brushes, and is said to outlast natural pig bristles 3 to 1. Furthermore, Nylon resists solvents.

Summer Management Course

A management course covering the three weeks from June 12 to 30 will be given this year, the same as previous years, at the College of Engineering of the State University of Iowa. This course will be devoted to production planning, plant lay-out, motion and time study, wage incentives, and related subjects. Tuition and laboratory fee for the three-week course is $150. For further information, address Ralph M. Barnes, director, summer management course, State University of Iowa, Iowa City, Iowa.

* * *

Industrial Training Films

A new series of industrial training 16-millimeter sound films, sponsored by the United States Office of Education, are said to have proved of considerable value in many factories. A survey indicates that training periods for new employes have been reduced by from 30 to 50 per cent through the employment of training films. These films are distributed through Castle Films, Inc., 30 Rockefeller Plaza, New York City. Some of the latest films released relate to machine shop practice, aircraft work, and shipbuilding.

* * *

High-Speed Motion Pictures in Industry

At a recent meeting of the Cleveland Engineering Society, H. D. McLarty, director of the Research Division of McLarty Business Films, Buffalo, N. Y., read a paper on "Ultra High-Speed Motion Pictures and Their Application to Industry and Research." In this paper, the author outlined the history and development of high-speed photography and its present status with regard to the study of high-speed motions in engineering design.

Heavy machinery now is shipped by air. Two Quickwork-Whiting rotary shears, each weighing 2000 pounds, were recently picked up at the Whiting Corporation's plant in Harvey, Ill., by an Army plane and flown overnight to the Lockheed Aircraft Corporation's plant at Burbank, Calif., where these machines were urgently needed. Within twenty-four hours of the completion of their assembly, the shears were in operation at the Lockheed plant

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A WAR-TIRED PLANT

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Competent lubricating engineers can check your machines upon request, setting up a flexible system adapted to your plant's needs, and without disturbing production. The objectives of such a plan are (1) proper lubrication of every machine; (2) establishing positive lubrication control; (3) reduction in number of varieties of lubricants required. This plan is presented to plant executives in concise and permanent form, easy to follow.

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Houghton lubricants are scientifically treated to enable fewer grades to cover more needs and to hold up longer under gruelling war production. These treatments include polymerization, high-film-strength, corrosion-inhibiting, gum solvency and oxidation stability. The Houghton Man can tell you how "Oil with Guts" can fortify the war-tired plant. Ask him, or write E. F. HOUGHTON & CO., Philadelphia 33, Penna.

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